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THE RISE OF MAN[1]

By Professor JAMES H. BREASTED

ORIENTAL INSTITUTE, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

WE are gathered here this morning to give some thought to the purpose and meaning of a new building associated with a great university. If this were a new building intended for the study and teaching of some branch of natural science, such as geology or chemistry or physics, we would seem to be engaged in a routine familiar to us all, for such laboratories have long been known to us at other large universities. It is an interesting fact, however, that we would find no parallel to this building in any other university, either in America or abroad. Far from mentioning this fact by way of gratifying our own vanity, I call your attention to it because it is a fact of which I am constantly conscious as laying upon us a great and unique responsibility. It is a fact which obviously raises the question "Why." When other universities have not recognized such a need, why this new building here and why the researches to be housed in it?

I have lived for more than forty years in daily realization of the need of such a building, and to me the natural question seems rather to be: "Why should science, which builds its laboratories to investigate the history of every other creature from the frog to the horse, never have created a laboratory for the investigation of early man, the most important of all creatures?" The investigations centering in this building make it a laboratory devoted to man, to his origins and the evolution of the civilization which we have inherited. The life going on in this building invites you to a new vision of the place of man in a universe out of which he has issued with new and sovereign powers to understand something of that universe and his own place in it.

MAN'S PLACE IN NATURE

For ages man has seen himself against a background of nature. Gradually his own achievements have profoundly modified his ideas of his own position in the visible world about him. When Stone Age man shifted from hunting to agriculture and for the first time felt his dependence on the fruitfulness of the earth, it led him to deify the fertility of the green

[1] Address given on the occasion of the dedication of the Oriental Institute of the University of Chicago.

fields and to take his place as a child of the god of fertility. It gave him a very simple idea of his place in the natural order. Since those primitive days the profoundest minds have struggled with the problem of man's place in nature. The self-development which was such a profound influence in the growth of Goethe's mind was conditioned by the expanding consciousness of his own kinship with nature and the belief that somehow man had come out of nature. These thoughts eventually issued in Goethe's profound conviction of his spiritual oneness with nature. A quarter of a century after Goethe died, Darwin published his "Origin of Species," and thereupon the conception of man's place in nature hardened into mechanical and largely biological aspects of the emergence of man. It was especially in the writings of such men as the Frenchman Taine that these mechanistic and biological conceptions revealed their devastating effect upon a trained mind, even though enriched by literary culture. Under the light of modern science and its terrifying revelations, man has begun to fear the tremendous idea that he is an outgrowth of the universe that holds him in its immutable grasp. To be sure, some minds like that of Tennyson have kept alive the spiritual attitude so strongly held by Goethe. We really hear an echo of Goethe as we contemplate the figure of Tennyson standing by the cradle and for the first time looking into the face of his first-born son, with the words, "Out of the deeps, my child, out of the deeps."

In an evolutionary age, however, there was little upon which this mystically spiritual attitude of Tennyson could be based.

The Gap in our Knowledge of the Human Career

Since then the natural scientists have labored on and the physical origins of man from the lower animals have become far clearer. But between the historians and the natural scientists there has been a "great gulf set," with the result that we now have on the one hand the paleontologist with his picture of the dawn-man enveloped in clouds of archaic savagery, and on the other hand the historian with his reconstruction of the career of civilized man in Europe. Between these two the paleontologist with his archaic savage on the one hand, and on the other the historian with his account of civilized Europe, stand we Orientalists endeavoring to bridge the gap. It is in that gap that man's primitive advance passed from merely physical evolution to an evolution of his soul, a social and spiritual development which divests evolution of its terrors. It is the recovery of these lost stages, the bridging of this chasm between the merely physical man and the ethical, intellectual man which is a fundamental need as man faces nature today. We can build this bridge only as we study the emergence and early history of the first great civilized societies in the Ancient Near East, for *there* still lies the evidence out of which we may recover the story of the origins and early advance of civilization, out of which European civilization and eventually our own came forth.

The Organization Needed for Bridging the Gap

That is the greatest task of the humanist to-day; but no group of Orientalists, however gifted or able, if organized solely as a university department, as teachers of the history and the languages of the Orient, can undertake to recover the evidence still lying scattered far across the hills and valleys of the Ancient Near East. What is required in the first place is such an organization as will permit the employment of a large group of efficient field men with practical archeological training, who can be associated with the philologists and historians of a university department of oriental languages. If sufficient funds are available the field staffs and the home department can cooperate in a far-reaching, two-fold process, first, of salvaging the vast body of evidence still surviving in the field, and second, of studying and interpreting the evidence as it is received from the field by the scientific staff at home. Thus the formerly more or less helpless university department of oriental languages becomes part of an effective organization, in which it serves as the interpretative organ. We thus link together the far-flung salvaging operations in the field and the interpretative group at home in one great cooperative organization.

The Oriental Institute

This organization of home and field staffs, which we have called the Oriental Institute, began its work in the autumn of 1919, and is therefore twelve years old. Its resources were at first very modest, consisting of a subscription of $10,000 a year for five years, contributed by Mr. John D. Rockefeller, Jr., in the spring of 1919. This personal subscription by Mr. Rockefeller, Jr., steadily increased, and at the same time the General Education Board and the International Education Board made large appropriations for the expansion of the new institute. It was, however, not until five years ago that the Oriental Institute was able to launch a comprehensive program of research, providing for a field expedition in each of the great ancient oriental civilizations of the Near East: These are now at work in Anatolia (Hittite civilization), Syria, Palestine, Assyria, Babylonia, Persia, Egypt and Northeast Africa, making a total of twelve expeditions. They form the most far-reaching archeological organization ever projected.[2]

[2] At this point congratulatory cablegrams received by the Institute from these expeditions were read by the

Thus for the first time a single organization is now able to control and to correlate the results of research and excavation throughout the leading early civilizations in a single composite reconstruction of the course of ancient human life before the rise of Europe. A small fraction of the evidence thus far recovered is installed in the museum halls which we are about to visit.

We shall pass through these halls, five in number, in the following order: Egypt, Assyria, Babylonia, Persia and Islam, Palestine and the Hittites.

Western Asia and the Rise of Business and Law

These names at once suggest the diversity of peoples which produced the composite civilization of Western Asia. Indeed, the history of Western Asia is made up of one brilliant eruption after another, arising from the intermingling of invaders and invaded. There is no unbroken evolution of a single society stimulated by the ferment and friction of its own internal forces. The foreign invader periodically diverts the development into new channels, and produces sudden dislocations in the evolutionary process, like the fall of Nineveh before a combination of foreign foes, or the capture of Babylon by Cyrus and the Persians. It is a vast and intricately complicated mosaic which we are endeavoring to piece together in Western Asia.

It was a still greater complex of civilization resulting from the commingling of the life of Egypt and Western Asia which eventually reached Europe and furnished the cultural basis on which European civilization arose. It was in the Near East that man developed the whole material basis of life, as grain and cattle, wool and manufactured merchandise gradually built up the earliest commercial world in the Near East at a time when Europe was still primeval forest. In the thousand years between 3000 and 2000 B. C., the merchants of Babylonia created the idea of credit which still binds together the great people of the world or leaves them helpless and disorganized when its cementing power breaks down, as it now seems to have done. You can enter our Babylonian halls and see there masses of business documents some of them reaching back to nearly 3000 B. C. The commercial and social relations which produced them built up a body of business customs which became inviolable and gradually took shape in laws, which long before 2000 B. C. were put together in a highly developed form by the great Hammurabi, whose remarkable code you may see in replica in the Babylonian Hall. Thus the work of man's hands in agriculture, cattle-breeding, manufactures and building merged into more highly developed forms of human organization. Society gained classes and men of gifts gained leisure.

The Rise of Art, Literature and Science

This situation made possible the earliest flowering of art and literature as the human mind discerned entirely new and undiscovered ranges where it might wander. In an address so brief, I can not even suggest the character and achievements of the earliest national art in Egypt and Western Asia. That until recently little was known of it, even in this university, may be observed from the fact that in his opening lecture, inaugurating the Renaissance Society, one of our own colleagues summarized the art of the Orient as "the winged bulls of Assyria and the jackal-headed Anubises of Egypt." In spite of this terrifying epigram we have since annexed one of the said winged bulls, and you can this morning decide for yourselves whether you regard it as successful art.

In literature I can make only one reference. I could show you a papyrus containing a government report embedded in which is a single statement disclosing admiration of a beautiful scene along the Syrian Coast. It was written in the twelfth century B. C., and it is the earliest surviving expression in human speech of man's love of beauty in nature—the beginning of a long development which has culminated in the poetry of Shelley and Wordsworth.

Through the obscuring veil of superstition men looked out upon a mysterious world, which they longed to understand, as we do to-day. The demand to do so was at first a social summons, the need of human suffering, which called forth efforts at alleviation. The oldest known treatise on surgery, which was written in Egypt nearly 5,000 years ago, discloses to us the thoughts of the earliest man who reveals a scientific attitude of mind. This treatise is therefore the earliest document in the history of science.

Less than a thousand years later the Egyptians were already writing mathematical treatises of astonishing penetration. The area of the circle was computed by taking eight ninths of the diameter and squaring it. The value of π thus gained was 3.1605, which differs less than two one hundredths from the value of π current at the present day. This led to a formula for computing the area of the surface of a hemisphere, a method rediscovered by the Greeks 1,300 years later. A recently deciphered papyrus at Moscow has disclosed a surprising ancient Egyptian formula for the computation of the cubical contents of a truncated pyramid, that is a pyramid cut off part way up in a plane parallel with the base. This formula, which was unknown to the Greeks, was first stated in Europe by Leonardo of Pisa in A. D. 1220,

speaker, including a remarkable forty-eight line inscription of Xerxes, just discovered at Persepolis.

three thousand years after it had been discovered by the Egyptians.

The supreme achievement of science in the Orient was Babylonian astronomy. As far back as the twenty-third century B. C. the Babylonian astrologers observed an eclipse of the moon which has been calculated to have occurred in 2283 B. C. But at that remote date such observations were only occasional, and they were likewise very inaccurate and unsystematic. Gradually it became customary to make more frequent observations, until 747 B. C., in the reign of the Babylonian king Nabonassar, the series of observations became continuous and a record of them was carefully kept on file. This file furnished the first long series of astronomical observations ever made by man, and therefore the first great body of astronomical knowledge. It is an extraordinary fact that modern astronomers have not yet been able to accumulate a series of observations equally long. The Babylonian series continued for over 360 years, while the longest known series of modern observations, that at Greenwich, which began in 1750, has now been going on about 181 years, or about half the length of the Babylonian series.

The use to which the Babylonian astronomers put these scientific archives is an astonishing demonstration of the scientific attitude of mind. About 500 B. C. the Chaldean astronomer Naburimannu was able to calculate the annual movements of the sun and moon with an error of less than ten seconds for the entire year. A little over a century later the Chaldean astronomer Kidinnu, whom the Greeks called Kidenas, greatly surpassed this accuracy, reducing the error in a year's revolution to one second. Indeed, one of his measures of celestial motions even exceeds in accuracy the figures that have long been in practical use by modern astronomers. This was because he had before him 360 years of lunar observations, and no modern astronomer has any such body of records at his disposal. Eventually Kidinnu discovered the slow change in the obliquity of the earth's axis which we call the precession of the equinoxes, an achievement hitherto attributed to the Greeks.

The Greeks Inherit Babylonian Astronomy

It is now obvious that Thales made his famous prediction of a solar eclipse on the basis of Babylonian observations, and we now know also that when the Greek engineer Meton was trying to introduce a scientific calendar at Athens, he took the length of his year from the Babylonian Naburimannu. These two remarkable Babylonians, Naburimannu and Kidinnu, who first revealed to men a majestic system of the celestial world and thus became the founders of astronomical science, were an imperishable scientific and intellectual bond between the early East and civilized Europe.

Undisturbed Evolution of Civilization in the Nile Valley

Such glimpses of early man's intellectual conquests, as revealed in surgery, mathematics and astronomy, disclose to us the fact that man was advancing for thousands of years at many points along a wide and imposing front. In Western Asia, as we have seen, that front was broken up by invasions and shifting movements of early populations which produced constant complications and make it increasingly difficult to follow the human advance. In the Nile valley, however, safe frontiers, while by no means impenetrable, made ancient Egypt a kind of social laboratory where we may watch almost uninterruptedly the successive stages of human evolution.

As you enter the Egyptian Hall in this building, you will find at the right a group of stone implements, all of which were found embedded in geological formations in the Nile valley. They therefore belong to known geological periods. They stretch from the earliest known stone artifacts almost down to the Late Stone Age or the Neolithic, and they form the first such geologically dated series of stone tools, covering a period of many thousands of years, ever discovered. During the period which produced them the Nile cut down its channel through a hundred vertical feet of solid rock. It was not until long after this period of probably several hundred thousand years, which we can follow only in gradually improving stone tools, that man gained cattle-breeding and agriculture. Thereupon with the development of a settled manner of life, the evolution gradually became a social process.

Man's Earliest Triumph over Material Forces

From that time to this, man's life has been periodically involved in a struggle between the tremendous impression received from the natural world and the humaner impulses that are engendered by social experience and social struggle. In the Nile valley we can watch the first of these periodic struggles, and with sympathetic understanding we can follow the first great age of spiritual disillusionment. We watch the triumphant conquest of material forces, at first slow and then moving with astounding rapidity as these ancient Nile dwellers came completely under the spell of their material triumphs.

In the Cairo Museum you may stand in the presence of the massive granite sarcophagus which once contained the body of Khufu-onekh, the architect who built the Great Pyramid of Gizeh. His name means "Khufu lives," or in its Greek form "Cheops lives"—certainly a significant name for the builder of a pyramid which is still the greatest of all masonry buildings. Who does not know the "Pyramid of Cheops"? Let us in imagination follow this early architect to the desert plateau behind the village of

Gizeh. It was then bare desert surface, dotted only with the ruins of a few small tombs of remote ancestors. The oldest stone masonry construction at that time had been erected by Khufu-onekh's great grandfather. Only three generations of architects in stone had preceded him. We can easily imagine Khufu-onekh's grandfather saying to him, "My father put up the first stone building ever erected in Egypt." There probably were not many stone masons, nor many men who understood the technique of building in stone as Khufu-onekh took his first walk on the bare Gizeh plateau, and staked out the ground plan of the Great Pyramid. Conceive, then, the dauntless courage of the man who told his surveyors to lay out the square base 755 feet on each side! When that was done Khufu-onekh was looking out over a square of naked desert containing thirteen acres. He must have looked across the Nile at the quarries some thirty miles distant, and perhaps he made a quick calculation: "It will take nearly two and a half million blocks each weighing 2½ tons to cover this square of thirteen acres with a mountain of masonry 481 feet high; but I will do it!" This is the first time in the history of man that we are thus able to put our yardstick athwart a human mind and take the measure of its courage in terms of cubic feet of masonry and colossal achievement in engineering never again to be equalled. The Great Pyramid of Gizeh is thus a document in the history of the human mind. It clearly discloses man's sense of sovereign power in his triumph over material forces. For himself and for his sovereign the Pharaoh's engineer was achieving the conquest of immortality by sheer command of material forces—an immortality that consisted in survival of the king's body sheathed in an imperishable husk of masonry.

The Egyptians, The Discoverers of Character; Man Discovers the Inner Values, The Dawn of Conscience

Here then was a man still under the tremendous impression of the physical world, the world about him, but not yet aware of the world within him. When five or six hundred years of desert storms had buffeted the Great Pyramid of Gizeh and its companions on the Sahara plateau, a thoughtful Egyptian looked up at the pyramids and sang of the colossal futility of merely physical survival of the body. The human soul had entered the first great age of disillusionment. We begin to hear remote voices that proclaim the utter futility of material conquest. As if, through the dust and tumult of an engrossing conflict, man for the first time caught something of the veiled splendor of the moral vision. He began to hear the voices within himself and out of the conflict of social forces, he gradually became conscious of the inner values. Thus the Egyptians were the discoverers of character. Not projected from the outside into a world of unworthy men by some mystic process which our old school theologians called inspiration or revelation, but springing out of man's own life, illumining the darkness of social disillusionment and inner conflict, a glorious vindication of the worth of man, the dawn of the age of conscience and character broke upon the world, a historically datable event, about 2000 B. C. It was the outgrowth of man's own social experience. It sprang out of his own soul, and no outworn theological doctrine of inspiration, no conception of a spotlight of Divine Providence shining exclusively on Palestine, shall despoil man of this crowning glory of his life on earth, the discovery of character.

Earliest Materialism Defeated by Man's Discovery of Character

In our museum halls we can actually look upon the evidence of the transition from the age of materialism to the age of conscience and character. You will find in our Egyptian Hall a group of twenty-seven statuettes with which a cemetery official who served under the shadow of the Great Pyramid nearly 5,000 years ago equipped his tomb. These painted limestone figures represent his household, his children and his servants engaged in grinding flour, mixing and baking bread, brewing beer, slaughtering cattle and poultry and cooking them; making pottery, casting metal, carrying their master's message, or with three harps and a drum, making music while he ate. Thus in the Pyramid Age, the first half of the third millennimum before Christ, the Egyptian conceived his needs in the hereafter as being purely physical gratification. Alongside the case containing these statuettes is a cedar coffin with raised lid, bearing on the inside pictures of the food and drink which carry on the old ideas of the needs of man beyond the grave. But on the inside of the lid is a long writing containing the earliest intimations that happiness in the next world will be dependent on worthy moral conduct in this world. There was a lapse of perhaps five hundred years between the cemetery official who wanted merely food and drink in the next world and the dead man who had his coffin so painted that as he lay in it and looked up at the lid, he would have staring him in the face the new fact that he might expect felicity beyond only as he had lived a worthy life here. To-day you may walk between these two cases in the museum and standing there contemplate the original evidences, the actual tokens of this supreme transition in the life of man in its rise from savagery to civilization: the first defeat of materialism—the earliest dawn of conscience, the discovery of character—the emergence of social idealism. This tremendous transition went

on as a process entirely independent of religion. It transformed religion, however, for it brought forth for the first time a god of brotherly kindness. While men lived as tillers of the soil they discerned only a god of fertility; when the state arose and men caught their first vision of a supreme personality they called their god a king. Then when society developed and the friction and ferment of social struggle had taught men kindness and forbearance, they saw a god of character and of brotherly kindness whom they called "the good shepherd," two thousand years before the Good Shepherd of Christian faith. It was thus from the richly colored palette of human life itself that man drew the colors with which he glorified his picture of his god. That splendid vision arose out of the earliest spiritual revolution. It was caught up and exalted by the Hebrew prophets and through them has brought into our lives a light which still shines from the East.

I have given you some rapid glimpses at a few of the new materials by which we have begun to bridge the gap between the emergence of physical man and the rise of Europe. It is by these researches that we are slowly creating what I have called the New Past. They form a task which must go on for centuries, and as it proceeds now and later, its results will disclose to us and to our posterity an ever clearer vision of the highest process in the universe, as far as we know it today—the unfolding life of man. It is to these purposes that we dedicate this building.

THE NATIONAL ACADEMY OF SCIENCES

AWARD OF GOLD MEDALS TO DR. ANNIE J. CANNON AND PROFESSOR HENRY B. BIGELOW

AT this year's autumn meeting of the National Academy of Sciences, held at Yale University from November 16 to 18, two gold medals were awarded. Introductory remarks by President William Wallace Campbell were as follows:

The National Academy of Sciences is fortunate in possessing financial foundations for the awarding of nine gold medals and one prize, at appropriate intervals of time. Two of the medals are to be presented to their recipients this evening.

The Henry Draper Medal, bearing the honored name of a deceased member of the academy, was established by the widow, Mrs. Henry Draper, in 1883. The committee charged with the duty of administering the Draper Foundation recently recommended to the academy, and the academy decreed, that the Henry Draper Medal be awarded to Dr. Annie J. Cannon, member of the staff of the Harvard College Observatory. The reasons for the selection of Miss Cannon as this year's recipient are as recorded in the committee's report to the academy. In the absence of Professor Henry Norris Russell, chairman of the committee, the report will be presented by his fellow member, Director Harlow Shapley.

The report was as follows:

The Henry Draper Medal is awarded by the academy "for notable investigations in astronomical physics." This provision has wisely been broadly interpreted. Among the twenty investigators to whom it has been given during the last forty-five years, the majority have naturally achieved distinction through their work in the observatory—for example, Pickering and Campbell. Others, like Rowland, Zeeman and the lamented Michelson, made their contributions in the laboratory, and a few, of whom Eddington is the chief, have worked in the theoretical field. Yet one characteristic is common to almost all. There are not more than three of the twenty who have not, at one time or another in their scientific careers, been actively engaged with spectroscopic matters.

To-day the academy, while departing, with excellent reason, from one precedent, confirms another. For the first time the Draper Medal—and indeed any medal of the academy—is awarded to a woman; and the notable investigations in astronomical physics which abundantly justify the decision have been *par excellence* in the field of spectroscopy.

When Pickering—the second Draper Medallist—was appointed director of the Harvard College Observatory fifty years ago, he aroused the criticism of the conservatives of that day by devoting his remarkable energy and enthusiasm, and the resources of the observatory, to investigations in the physical side of astronomy.

Far from the least among these was the systematic observation and classification of stellar spectra. With a telescope affording a wide field of good definition, and having a prism placed before its objective, the spectra of hundreds of stars can be photographed simultaneously on one plate, so that there was no difficulty in securing observational material. But to record the results of investigation adequately for thousands of stars, and yet in a form not too bulky for publication, was no small problem. If stellar spectra presented the vast variety which is exhibited by living organisms the situation would be almost hopeless; but fortunately they are much less diverse. Hundreds of stars show spectra which are practically indistinguishable from one another under any ordinary dispersion, so that a relatively small number of symbols suffices for the description of the vast majority of spectra.

The Harvard observers very wisely decided to make these symbols purely formal, without any theoretical connotation. Mrs. Fleming employed letters of the alphabet, Miss Maury Roman numerals. Miss Cannon—our medallist of to-day—coming to her work a little later revised and refined the former system, and thirty years ago gave it the form which, with trifling changes, is now internationally adopted.

It is generally known as the Draper Classification, for the work on which it was based was supported by the Henry Draper Memorial—a gift to Harvard by the widow of Dr. Henry Draper, a pioneer investigator, who obtained in 1872 the first photograph showing lines in a stellar spectrum. Our academy likewise owes the Draper Fund and Draper Medal to Mrs. Draper's generosity, and it is especially fitting that we should recognize, by the award of the Henry Draper Medal, the long and productive labors of the investigator who has done far more than all others to give the Henry Draper Memorial the distinguished place which it occupies and must permanently continue to occupy in the history of astronomy.

Miss Cannon's introduction to her first "Catalogue of the Spectra of 1,122 Stars" describes the criteria upon which her classification is based so well that it has ever since been the standard authority upon the subject. No clearer statement could be made to-day of the great principle upon which the system is based —that almost all stellar spectra can be arranged in a continuous linear sequence. Though the spectra of stars near opposite ends of the sequence—for example, of Sirius and Arcturus—are so unlike that they seem at first glance to have hardly anything in common, yet a succession of stars can be found whose spectra differ from one another by barely perceptible degrees, and together form a complete transition from one to the other, and this transition is always through the same intermediate stages—there is no alternative path.

The older classification had assigned letters of the alphabet to various more or less obviously different spectra, as they appeared on the photographs. The newer dropped from the list those letters which proved to correspond to poor photographs or unimportant differences, and in some cases rearranged the order to agree with that of the linear sequence whose existence had become unquestionable.

By the survival of the fittest, the letters O, B, A, F, G, K, M were left to represent standard types along the sequence. Intermediate spectra are represented in the Draper Classification by a decimal notation, B_0, B_2, B_3, B_5, B_8 being successive stages in the transition from B to A. The resulting system has proved so convenient that all it has since required is the addition of affixes to take account of certain details which had necessarily to be ignored in the pioneer work. With this admirable system at hand, our medallist faced a task which might have appalled even the stoutest heart—the observation and classification of the spectra of all the stars in the heavens which could be photographed with the instruments of the Harvard Observatory—at that time the most powerful in the world for this purpose. It was no longer a question of thousands of stars, but of hundreds of thousands. The mere mechanical arrangement of the work, the identification of the stars, the recording and indexing of the observations, demanded careful planning and extensive clerical assistance.

This labor of years culminated in the publication of the nine volumes of the Henry Draper Catalogue, which give the positions, magnitudes and spectra of 225,300 stars, covering the whole heavens from pole to pole, and including all the stars brighter than the 8th magnitude and many which are fainter. Every one of these spectra has been examined and classified by our medallist in person. There is probably no other instance in the history of science where so great a mass of important data has been obtained by a single observer on a homogeneous and uniform system.

With the completion of the great catalogue seven years ago, a less devoted observer might have felt justified in resting. But improvement in observational technique had made it possible to photograph the spectra of fainter stars, and so the "Henry Draper Extension" was begun.

This extends the observations down to magnitude 11.5, and sometimes below. The number of stars which might be observed is now so great that it is impracticable to wait until the whole heavens have been covered, and then publish a general catalogue, and the results for various regions of the sky are being published as they are obtained. About one hundred thousand spectra have already been classified, and the work still continues. Long may it prosper!

The value of these great catalogues can hardly be overstated. Knowledge of the spectral type must lie obviously at the very foundation of any investigation of the colors, temperatures, real and apparent diameters and physical constitution of the stars. It has proved to be of almost equal importance to the investigators of their distances, motions and distribution in space.

Even in such an apparently local problem as the determination of the solar parallax by observations of an asteroid, the observer must know the spectra of his reference stars if he is to avoid the peculiarly troublesome errors which come from differences in color of the stars and of the planet. It is, indeed, hard to specify any branch of the study of the stars in which these great catalogues of spectra are not already almost indispensable.

With these consequences of her work—fascinating as they are—our medallist has concerned herself but little. True to the ancient tradition of the observer, who labors cheerfully for the joy of the work, and only rejoices the more that other men of different interest will enter into his labors and base their own upon them, she has used her unique skill and experience in the steady accumulation of a great addition to the permanent capital of astronomical science—a fund which, itself remaining intact, will continue to produce income in the work of astronomers yet unborn, who may well "rise up and call her blessed."

President Campbell then said:

The Agassiz Medal, awarded by the academy in recognition of valuable contributions to the science of oceanography, represents also a most commendable spirit of internationalism. The financial foundation was provided in the year 1911 by the celebrated Scotch oceanographer, Sir John Murray, in honor of his friend, Alexander Agassiz, member of the academy from 1866 until his lamented death in 1910, and president of the academy during the period 1901 to 1907. The committee on the Murray Fund recently recommended, and the academy decreed, that the Agassiz Medal be awarded to Professor Henry Bryant Bigelow, director of the Oceanographic Institution at Woods Hole. The reasons which governed the selection of Dr. Bigelow as this year's recipient of the medal will be stated, in the absence of Professor Lillie, chairman of the committee, by his fellow member, Professor George H. Parker.

Professor Parker said:

Professor Henry Bryant Bigelow, who is to receive this evening the Agassiz Medal, has only recently passed the half-century mark. He was trained in the Harvard laboratories and took his doctor's degree there in 1906, but before he had attained this distinction he had begun work on subjects dealing with the sea.

His first paper, entitled "Birds of the North-east Coast of Labrador," appeared in 1902. In the winter of 1901–02, he accompanied Mr. Alexander Agassiz on a voyage to the Maldive Islands, and in 1904 he published his report on the jelly-fishes of this expedition. In 1904–05, he again accompanied Mr. Agassiz, this time on the expedition to the eastern tropical Pacific; and in 1909 he published his very extensive report on the Medusae of this expedition, and two years later the report on the Siphonophores.

Meanwhile, through the advice of Sir John Murray, he began to take an active interest in the oceanography of the New England waters. In 1908, the U. S. Fisheries schooner *Grampus* was sent under his general management on an expedition to the Gulf Stream, a report of which he published in 1909. This initiated his extensive series of studies of the waters of the Gulf of Maine. These were made possible largely through cooperation with the U. S. Bureau of Fisheries, which repeatedly put at his disposal the use of the *Grampus*. In 1914 he reported on the oceanography of this region, and in the same year he published an account of the plankton of Massachusetts Bay. This was followed by a report on the oceanography and plankton of the waters between Nova Scotia and Chesapeake Bay. In 1917 an additional report was made on the region from Cape Cod to Halifax. Then followed the three extensive contributions of 1926 and 1927 covering the plankton of the Gulf of Maine, its dynamic oceanography and its physical oceanography. Meanwhile, in conjunction with William Welsh, he had issued his important volume on the fishes of this region. The proposal for an ice patrol as a means of greater security for shipping in the North Atlantic had been taken up by the United States Government, and, in association with Lieutenant Smith, Bigelow worked out much of the details of this organization. A report on this subject was published by him in 1929.

As work progressed the conviction grew upon him that an oceanographic institution should be started on the Atlantic coast of the United States, and he reported on this subject to the National Academy of Sciences in 1930. The material of this report was finally issued in the form of a volume entitled "Oceanography, its Scope, Problems and Economic Importance." This volume was published in 1931 and was distributed to the members of the academy. As a result of these activities the Woods Hole Oceanographic Institution was organized and a building to house it was erected near the Marine Biological Laboratory at Woods Hole and opened this past summer. Dr. Bigelow is serving as its first director.

I can not conclude this rather bare description of Bigelow's oceanographic activities without a closing note of warning. Bigelow was reputed to have been far from a diligent scholar. In his student days, one of his old teachers, long since past, took him aside, so I am informed, and told him that he would do well to withdraw from the Harvard laboratories, for he was both negligent and idle. Would that that teacher could be here this evening to face him and to tell us, who are also teachers, how easy it is to misjudge the young who come to sit at our feet. We who know Bigelow are well aware that the real salt of the sea flows in his veins and that he will devote himself to the end of his days to the promotion of oceanography.

Mr. President, your committee took the greatest pleasure in recommending to the National Academy of Sciences for the award of the Agassiz Medal Professor Henry Bryant Bigelow, associate and lifelong

friend of Alexander Agassiz, and an oceanographer of the highest standing.

CENTENARY OF THE BIRTH OF OTHNIEL CHARLES MARSH

AT the dinner of the National Academy of Sciences at the New Haven meeting, Professor Charles Schuchert was called upon by President Campbell and presented the following statement and resolution:

By an odd coincidence, I was at Lockport in the western part of New York on the 29th day of last October, for the purpose of visiting the birthplace, the youthful environment and the ancestral grave of Othniel Charles Marsh. That day one hundred years ago a child was born in that village, of humble parents, Caleb Marsh and Mary Peabody, whose forebears were amongst the first settlers of old Massachusetts. This boy was destined to be for twelve years the president of our distinguished academy.

Graduating at Andover and Yale, and then spending several years at the seats of learning in Heidelberg, Breslau and Berlin, Marsh was appointed in 1866 to the chair of paleontology at Yale, the first professorship in that science in any institution. Beginning with the seventies and until the end of his life in 1899, he brought to light in rapid succession so many astonishing antediluvian animals that the unexpected became the rule with him. He revealed over and over again in complete skeletal restorations the medieval and Tertiary animals of our bad lands of the high plains. One of the strongest of personalities, Marsh in his time "stood without a peer" in his chosen field of endeavor. "To Yale he gave his services, his collections, and his estate."

At the height of Marsh's scientific career came what he regarded as the greatest honor of his life, namely, election to the presidency of this academy, and from 1883 to 1895 he served it, and through him it often became the adviser of the government in matters of a scientific nature. Over the academy he watched with as much of interest and care as over his personal affairs.

In view of these circumstances, I present the following resolution:

Resolved, That in this year which marks the centenary of the birth of Othniel Charles Marsh, and in the environment where he lived and worked so long, the academy recalls with pride the personality and mental gifts of that great paleontologist, whose distinguished service as its president was entirely in keeping with a lifetime of uninterrupted devotion to science.

In response to this resolution, Professor Richard Swann Lull spoke as follows:

Professor Marsh's birth and early training have been mentioned by Professor Schuchert. It is appropriate to express in greater degree something of his services to Yale University, especially to the Peabody Museum of Natural History with which he was so closely identified.

Coming to Yale as professor of paleontology in 1866, Marsh's services covered just a third of a century.

Inspired by a trip to the west in 1868, when he actually found a three-toed horse and is said to have discovered the first dinosaur bone found in the Rocky Mountains, he was filled with a desire to continue his search for fossils in the great west. The first formal expedition went west in 1870, and thereafter until 1873 parties, consisting largely of students or men recently graduated from Yale College and the Sheffield Scientific School, went annually to search for the scientific treasures which the region revealed. Marsh's choice of members for these parties was admirable, for almost invariably they were men who subsequently made their mark in the world, though few if any went into paleontology as a profession. Cooperation with the military authorities was obtained, and cavalry escort against the possibility of Indian attack was the usual thing. After 1873, the Indian menace becoming more acute, the student expeditions were abandoned and thereafter material was gathered by paid collectors, former guides and others, many of whom became famous in the archives of the museum. Later, as United States vertebrate paleontologist, collections were made for the U. S. Geological Survey as well as for himself and assembled here at Yale as the basis of a series of projected monographs, but two of which he lived to complete.

In 1898 Marsh's share of his collections was presented to the president and fellows of Yale, and after his death the United States material was separated out and transferred to the U. S. National Museum. His work as a collector has thus served greatly to enrich two institutions.

Not content with this, Marsh published a continuous stream of papers descriptive of the collections, and the world's knowledge of curious and bygone forms, of species and genera, families and even orders as yet unheard of was thereby vastly increased.

His anatomical knowledge was marvelous, and his paper restorations, though in but one plane of space and therefore open to possible error, became classic. To those of us who are privileged to carry on his work, the storehouse seems inexhaustible, and we are struck with the almost uncanny accuracy with which he seized upon the essentials of a new and but partially complete or developed specimen upon which to base his terse but significant description of a new species. While these descriptions, in the light of fur-

ther revelation, can often be amplified, they can rarely be improved.

Then, too, as we are privileged to mount one after another of his paper-restored creatures, we are so impressed with his accuracy that if we would differ from the findings of the master, we must indeed show cause. The last of these is the magnificent specimen the mount of which is just completed. Living and dying in the Jurassic age, this monster lay entombed in Como Bluff, Wyoming, 120,000,000 years. Collected half a century ago it was sufficiently prepared to form the original type of a genus and species and to serve as the basis for the most remarkable of Marsh's restorations. Partly mounted in the old museum twenty years later, it was made the chief thing in our imagination around which the great hall of the new museum was built, and now, after fifty years, it stands again in its majesty, the fruition of the last three years of intensive work! When you go to the museum tomorrow to view its treasures which we have been privileged to display, the skeleton of *Brontosaurus excelsus* will, as the name implies, excel them all.

May I be permitted to read the tributes of two eminent men, preserved among the archives of the Peabody Museum?

To Clarence King, Director of the United States Geological Survey.

NEWPORT, Aug. 19, 1876.

MY DEAR SIR:

In accordance with your wish, I very willingly put into writing the substance of the opinion as to the importance of Prof. Marsh's collection of fossils which I expressed to you yesterday. As you are aware, I devoted four or five days to the examination of the collection and was enabled by Prof. Marsh's kindness to obtain a fair conception of the whole.

I am disposed to think that whether we regard the abundance of material, the number of complete skeletons of the various species, or the extent of geological time covered by the collection, which I had the good fortune to see at New Haven, there is no collection of fossil vertebrata in existence which can be compared to it. I say this without forgetting Montmartra, Sivalik, or Pikermi.

And I think that I am quite safe in adding that no collection which has hitherto been formed approaches that made by Prof. Marsh in the completeness of the chain of evidence by which certain existing mammals are connected with their older tertiary ancestry.

It is of the highest importance to the progress of biological sciences that the publication of this evidence, accompanied by illustrations of such fulness as to enable palaeontologists to form their own judgment as to its value, should take place without delay.

I am

Yours very sincerely,

(signed) THOMAS H. HUXLEY

DOWN,
BECKENHAM, KENT.
RAILWAY STATION
ORPINGTON. S.E.R.

Aug. 31 1880

MY DEAR PROF. MARSH:

I received some time ago your very kind note of July 28th, and yesterday the magnificent volume. (The Monograph on the Odontornithes, Extinct Toothed Birds of North America.) I have looked with renewed admiration at the plates, and will soon read the text. Your work on these old birds and on the many fossil animals of N. America has afforded the best support to the theory of evolution, which has appeared within the last 20 years. The general appearance of the copy which you have sent me is worthy of its contents, and I can say nothing stronger than this.

With cordial thanks, believe me

Yours very sincerely,

(signed) CHARLES DARWIN

When one bears in mind that this letter was written approximately twenty years after the publication of the "Origin of Species" we realize the fulness of Darwin's tribute to Othniel C. Marsh.

SCIENTIFIC EVENTS

ECOLOGICAL NOMENCLATURE

THE following extracts from a letter to its members which was printed in the June *Bulletin of the Ecological Society of America* were intended to obtain suggestions concerning uses and abuses of ecological nomenclature which might be discussed by the newly formed committee on nomenclature and then assembled for presentation to the society at the New Orleans meetings. Knowing that many persons, not members of the Ecological Society, are actively interested in these questions, the committee believes that it may be worth while for SCIENCE to republish the essential points before the New Orleans meetings so that suggestions may be given to the committee by non-members of the Ecological Society as well as members. The committee is trying to work in the interest of all who make use of ecological terms, therefore it requests that any individual who cares to make a suggestion will give it to one of the members of the committee, preferably before the New Orleans meetings.

(1) In ecological discussions, written or spoken, what terms have you found to be used so loosely as to seem

in need of better definition? At the Cleveland meeting "marsh" and "swamp" were mentioned as possible examples. Although, like many other words useful in ecology, these two often have very close resemblance (or even synonymy) in popular usage, it is possible that they could be made to indicate definite differences in practice of ecologists. The committee would like to have a list of such terms as are known to you, together with such comment as you care to make.

(2) Should the society encourage plant ecologists, animal ecologists, agronomists and other limited groups to formulate their own terminology and definitions, or should the society endeavor to help standardize ecological concepts to embrace the whole field so that all specialists, so long as their point of view is ecological, could understand all the rest?

(3) Can you suggest terms, or some usage of terms, which will help one to express the distinction between waxing and waning phases of environmental influences; *e.g.*, those involved in increasing or decreasing degrees of heat?

The committee is agreed, and probably most members of the society concur, that it is not practicable or desirable to attempt to force improvement by legislation, but it does seem possible that improvement may follow responsible suggestions and formal recommendations if they can be offered in a form suited to existing needs.

Submitted by the Committee on Nomenclature of the Ecological Society of America.

H. C. HANSON
State College, Fargo, N. Dak.
J. G. NEEDHAM
Cornell University, Ithaca, N. Y.
WALTER P. TAYLOR
c/o University of Arizona, Tucson, Ariz.
A. G. VESTAL
University of Illinois, Urbana, Ill.
W. E. ALLEN, *Chairman*
Scripps Institution, La Jolla, Calif.

EXHIBIT OF SPECIMENS OF HIMALAYAN FLORA AT THE ROERICH MUSEUM

AN exhibition of fifty mounted botanical sheets, representing examples of the Himalayan flora, has been opened at Urusvati, Himalayan Research Institute of Roerich Museum in New York City. The loan is part of a herbarium of 3,800 specimens presented to the New York Botanical Garden by the Himalayan Research Institute Headquarters in India, and has been identified personally by Dr. E. D. Merrill, director-in-chief.

The scientific value of the herbarium collections assembled by the institute, as well as the purpose of the collections, are significant. Bio-chemical and cancer research laboratories are now being built at the headquarters of the institute in the Himalayas for their investigation from a medicinal viewpoint. In this connection, also, a careful survey is being made of the Tibetan pharmacopoeia and medicinal literature. Over two hundred items, including native drugs and medicinal herbs, have already been secured, and valuable medicinal texts on therapy and pharmacology, including the *rGyud-bshi* and a number of *gter-ma* or "hidden" books on the Tibetan medicines, have been obtained. The Tibetan pharmacopoeia is known to be particularly rich, and to have in its possession, since time immemorial, remedies against cancer and tuberculosis which are said to have been used with success. It is the purpose of the institute to investigate these remedies.

The present exhibit at the Roerich Museum includes specimens of the Himalayan flora, which is a very diversified and interesting one, containing many species of marked beauty. Flowering plants, ferns and fern allies, hepatics, lichens and fungi are among the specimens represented. They were secured at altitudes ranging from 5–12,000 ft. elevations to the perpetual snowpeaks of Tibet, during the botanical-zoological expeditions in 1929–1931 under Dr. Walter Koelz, of the staff of the institute.

The most recent explorations of Dr. Koelz, during the summer of 1931, have led him into inmost Asia, through Lahul, the Indus Valley and Ladak; 26 mountain passes, some of them 18,000 to 19,000 feet, were crossed, and the expedition led past the great salt lakes of Tibet, one of them, the Pangong La, being 90 miles in length. Four months were consumed by the journey. According to a preliminary report by Dr. Koelz, sent by Dr. George Roerich, director of the Himalayan Research Institute, to the Roerich Museum in New York, 1,000 plant numbers (some 15,000 specimens) were obtained, and 25 big game animals—including ibex, napo, gazelle, kiang, ovis ammon, shapu, etc.—as well as a number of smaller mammals, were also collected. The report continues: "Much of the area visited has not been biologically explored previously, and in the area that has been studied ornithologically, the expedition's work has added new records to the bird fauna. None of the territory explored is under 9,500 ft. and much over 14,000 ft. . . . The vegetation is striking. Barley ripens at 15,000 ft. in places, and exquisitely fragrant, showy flowers abound on the peaks to elevations of 18,000 and 19,000 ft.; these are not dwarfed, stunted plants such as one usually finds in alpine zones, but often a foot or two in height."

THE INTERNATIONAL METEOROLOGICAL ORGANIZATION

PROFESSOR C. F. MARVIN, chief of the U. S. Weather Bureau, has returned from Europe where he attended meetings of the International Meteorological

Organization at Locarno, Switzerland, and also the fourth general conference at Geneva, Switzerland, of the advisory and technical committee on communication and transit of the League of Nations, involving consideration and discussion of the projected matter of the reform of the calendar.

According to an account in the *Official Record* the matter of first importance in connection with the meeting at Locarno was the fact that the so-called executive council, consisting of representatives of five nations, one of these representatives being the president of the International Meteorological Organization, held its first meeting after it was created at the conference of directors at Copenhagen in 1929. This was, therefore, its organization meeting. In addition to deciding upon necessary rules and regulations for accomplishing the work of the council, decisions were reached in regard to the budget and funds for the maintenance of the office of the secretariat during the forthcoming year and the projects tentatively under way were approved. With some modifications these rules and regulations were subsequently approved by the International Meteorological Committee, and they have now become the permanent guide for this new feature of the work of the International Meteorological Organization.

The major part of the sessions of the committee was devoted to the reading of reports by the president of the Upper Air Commission, which held its meeting in Madrid recently, and the president of the Polar Year Commission, following the meeting of that and some other commissions at Innsbruck, Austria, in September. The committee devoted considerable time to discussion of the numerous resolutions that resulted from the reports mentioned, and these resolutions, with such modifications as were deemed necessary, were approved or indorsed by the International Committee.

Also meetings were held of the subcommission on organization of the meteorological work of the oceans, more particularly with reference to the ship report work from selected ships on the North Atlantic. Some of the difficulties in connection with the reception and distribution of reports were discussed, and agreements were reached with a view to realizing more uniform and better and more valuable service in the future. Professor Marvin reports that:

> It is important to mention in this connection that almost coincidentally with these meetings at Locarno, in connection with ship reports from the oceans, an international conference of radio-marine organizations was held in New York, at which particular consideration was given to the agreement among all radio organizations to transmit meteorological reports from ships at sea free of cost for what is called the "ship tax," in view of the important benefits that navigation, including radio interests, receive from the free dissemination by meteorological services of forecasts, warnings and important meteorological information.

Perhaps one of the most important actions taken at the Locarno meeting was the decision that, notwithstanding the difficulty confronting the various nations at the present time, the program of intensive observational work which had been previously planned and provided for by nearly all nations for the so-called polar year, beginning with August, 1932, and extending to August, 1933, should be carried through, although it was recognized that the critical situation might make it impracticable to carry out all the features of the program originally contemplated.

THE FOURTEENTH INTERNATIONAL CONGRESS OF PHYSIOLOGY

THE Fourteenth International Congress of Physiology will be held at Rome from August 29 to September 3, 1932. The officers of the congress are Professor Filippo Bottazzi, professor of physiology in the University of Naples, *president;* Professor G. Quagliariello, of the Institute of Chemical Biology at Naples, and Professor S. Visco, of the Institute of General Physiology at Rome, *secretaries.*

The international committee is composed of Filippo Bottazzi, Naples, who is organizing the congress; Archibald W. Hill, London; Otto Frank, Munich; William H. Howell, Baltimore; John E. Johansson, Stockholm; Louis Lapicque, Paris; I. P. Pawlow, Leningrad.

The meetings will be held in the Institutes of Physics, Chemistry, Pharmaceutical Chemistry, Botany and General Physiology of the Royal University of Rome. These institutes are within short distances of one another, in Via Panisperna 89A, and in Via Milano 71 and 75. The membership fee is 100 lire.

During the congress, besides visits to the various museums in Rome, to the Roman Forum, to the Palatine, etc., members may take part in free trips that have been provided to either Villa Adriana and Villa d'Este, or Ostia-Scavi and Ostia-Lido. After the congress, a trip to Naples with a visit to the Zoological Station, and free excursions by registered members to one of the following places will be arranged: Campi Flegrev (Solfatara) and Curma; Vesuvius and Pompeii; Herculanum and Paestum. Those will be considered registered who have remitted the membership fee, to the following address: Presidente del Comitato organizzatore del XIV Congresso Internazionale Fisiologia, S. Andrea delle Dame, 21, Napoli (Italy).

Since a large attendance is anticipated it is necessary that each member should present one paper only. Papers not read can be published in the volume of the proceedings. Abstracts of the papers in one of the four official languages (English, French, German,

Italian) must be sent to the president of the congress during the month of May (1932). Those desiring to give experimental demonstrations are requested to specify their requirements, not later than May.

A list will be published in due time of the hotels in Rome and Naples with prices for board and lodging. All necessary information for reserving accommodations in these hotels will be given. To members coming from America, Australia, etc., information will be given in due time concerning the boats upon which passage to and from the congress may be procured. The Italian Government will grant a reduction in the prices of railway tickets from the Italian frontier or from the Italian port of landing to Rome and Naples as well as from Rome or Naples to the frontier or to the Italian port of sailing.

PRESENTATION OF A PORTRAIT OF PROFESSOR CHARLES E. MUNROE TO THE COSMOS CLUB

AN oil painting of the distinguished chemist, Professor Charles E. Munroe, of the Bureau of Mines, was presented to the Cosmos Club of Washington, D. C., on December 9, by Dr. Henry G. Knight, chief of the U. S. Bureau of Chemistry and Soils, on behalf of more than 200 friends, associates and former students of Dr. Munroe. The painting, which represents Dr. Munroe seated, glancing up from a manuscript which he has been reading, was the work of a Washington artist, Mr. Hermann Ludden.

At the presentation exercises presided over by Dr. Knight, Dr. Marcus Benjamin, of the Smithsonian Institution, and Dr. Henry S. Washington, of the Geophysical Laboratory, spoke of Dr. Munroe's achievements; Dr. Munroe and the artist responded; Dr. Knight presented the portrait, which was accepted for the Cosmos Club by Dr. William C. White, president, and Dr. Lyman J. Briggs, chairman, of the art committee of the club.

Dr. Munroe has been active in scientific circles in Washington for fifty years. He has been president of the Cosmos Club, the Washington Chemical Society and the American Chemical Society and is an honorary fellow of the American Institute of Chemists. For many years he was dean of the Graduate School of George Washington University and served for several years as a member of the National Research Council.

The plan to present the portrait was sponsored by a distinguished committee which included Dr. A. C. Fieldner, of the Bureau of Mines; Dr. R. E. Gibson, president of the Washington Chemical Society; Dr. H. G. Knight; D. F. J. Lynch, president of the Washington Chapter of the American Institute of Chemists; former Chief Justice Walter I. McCoy, president of the Harvard Club of Washington; Dr. Cloyd H. Marvin, president of George Washington University, and Dr. H. S. Washington, of the Carnegie Institution. Dr. J. F. Couch acted as secretary-treasurer for the committee.

SCIENTIFIC NOTES AND NEWS

DR. ALBERT EINSTEIN, of the University of Berlin, passed through the Panama Canal on December 19 on his way to California, where he plans to spend two months at the California Institute of Technology and the Mount Wilson Observatory.

PROFESSOR A. B. LAMB, of Harvard University, has been elected president of the American Chemical Society for 1933. The president for 1932 is Dr. L. V. Redman, vice-president and director of research of the Bakelite Corporation, who succeeds Professor Moses Gomberg, of the University of Michigan, on January 1.

DR. IRVING LANGMUIR, of the General Electric Company at Schenectady, a former president of the American Chemical Society, was elected to honorary membership in the Chemists' Club, New York, at a meeting of its members on November 11.

THE John Scott Medals of the City of Philadelphia, for inventions in science and industry that "may add to the comfort, welfare and happiness of mankind," were presented at the recent annual meeting of the American Society of Mechanical Engineers in New York City. The recipients were Albert Kingsbury, of Greenwich, Connecticut, "for the invention of a thrust bearing for use in ships and heavy machinery"; Albert H. Emery, Jr., of Stamford, Connecticut, "for the invention of the Southwark-Emery testing machine, a mechanical device for testing materials"; and Willis H. Carrier, of Newark, New Jersey, "for the invention of a process and apparatus for cleaning, purifying, and humidifying the air." At the same meeting of the American Society of Mechanical Engineers Mr. Kingsbury received the society's gold medal, for research work and development in lubrication.

THE employees of the Abbott Laboratories, North Chicago, Illinois, have presented an oil portrait of himself to Alfred S. Burdick, celebrating his tenth anniversary as president of the company. Resolutions signed by the 750 employees of the company were also presented to Dr. Burdick, voicing their affection and appreciation of his leadership in the ten best years of the company's history.

THE *Journal* of the American Medical Association reports that in memory of Professor Arkovy, professor of stomatology in Budapest, the Hungarian Society of Stomatology has created a gold medal to be awarded every three years, by an international committee, to the stomatologist adjudged the most eminent. The first award of the medal has been to Dr. Chompret, stomatologist to Paris hospitals, who will retire at the end of this year from active service. He was the founder and has remained the director of the principal dental school of Paris.

THE Mackenzie-Davidson Medal of the British Institute of Radiology and Röntgen Society was presented on the occasion of the annual dinner on December 4 to Professor Hans Holfelder, of the University of Frankfurt.

AT the forty-ninth meeting of the American Ornithologists Union, Joseph Grinnell, of the University of California department of zoology, was reelected to the presidency. Other officers are: A. C. Bent, Taunton, Massachusetts, and J. H. Fleming, Toronto, *vice-presidents;* T. S. Palmer, Washington, D. C., *secretary;* W. L. McAtee, Washington, D. C., *treasurer.* Additional members of the council are James P. Chapman, Ruthven Deane, H. C. Oberholser, J. L. Peters, C. W. Richmond, T. S. Roberts and P. A. Taverner.

AT the forty-second annual meeting of the Association of American Medical Colleges, held in New Orleans on November 30, December 1 and 2, the following officers were elected for the ensuing year: *President,* Dr. Louis B. Wilson, director of the Mayo Foundation of the Graduate School of the University of Minnesota; *Vice-president,* Dr. H. G. Weiskotten, dean of the Syracuse University School of Medicine; *Secretary-treasurer,* Dr. Fred C. Zapffe, 25 East Washington Street, Chicago (reelected); *Members of the Executive Council,* Drs. C. C. Bass, Tulane University, and G. Canby Robinson, Cornell University. The next annual meeting will be held in Philadelphia, probably during the first week in November, 1932.

THE American Pharmaceutical Association has announced as the result of the mail ballot for officers of the association, the election of the following: *President,* W. Bruce Philip, San Francisco, California, now of Washington, D. C.; *First Vice-president,* Rowland Jones, Gettysburg, South Dakota; *Second Vice-president,* G. H. Frommet, Miami, Florida; *Members of the Council* (for three years), J. H. Beal, Camp Walton, Fla.; C. H. LaWall, Philadelphia, Pa; C. E. Caspari, St. Louis, Mo. These officers will be installed at the next annual meeting which will be held in Toronto, from August 22 to 27, 1932. This meeting will be a joint meeting with the Canadian Pharmaceutical Association.

DR. EDWIN O. JORDAN, professor of bacteriology at the University of Chicago, was elected president of the Institute of Medicine of Chicago at its annual meeting on December 1, to succeed Dr. Otto L. Schmidt. Dr. Arthur R. Elliott was elected vice-president, and Dr. George H. Coleman was reelected secretary; Dr. John Favill is treasurer and Dr. Ludvig Hektoen, chairman of the board of governors. Dr. Schmidt's presidential address was entitled "The Rôle of Medical and Hygienic Museums in Education."

THE New York section of the American Chemical Society has chosen Dr. Walter S. Landis, vice-president of the American Cyanamid Company, as its chairman for 1932, succeeding Professor Arthur E. Hill, of New York University. Professor V. K. LaMer, of Columbia University, was named vice-chairman, and Dr. David P. Morgan, Jr., of Scudder, Stevens & Clark, secretary and treasurer. Dr. J. G. Davidson, of the Carbide and Carbon Chemicals Corporation, was named to the executive committee, other members of which are Mr. J. G. Detwiler, Professor Arthur E. Hill and J. M. Weiss.

DR. HUGO ROESLER, formerly of the University of Vienna, Austria, has been appointed assistant professor of radiology at Temple University School of Medicine, Philadelphia.

DR. JAY ARTHUR MYERS has been promoted from associate professor to professor of preventive medicine at the University of Minnesota School of Medicine.

DR. DENK, who was recently appointed professor of surgery at the University of Vienna as the successor of Professor Hochenegg, took as the subject of his inaugural address "Modern Methods of Combating Cancer."

CHARLES MILTON, Ph.D. (Johns Hopkins, '29), has been appointed geochemist and Kenneth D. Lohman, A.M. (California Institute, '30), assistant geologist in the U. S. Geological Survey.

PROFESSOR GEORGE W. PIERCE, director of the Cruft Memorial Laboratory at Harvard University, and Professor Alfred C. Lane, of Tufts College, are conducting in the Harvard physics laboratory a series of investigations to determine whether or not samples of uraninite ore mined in the Wilberforce Area, Ontario, Can., contain a sufficient amount of radium to make the ore commercially workable.

DR. E. G. CONKLIN, professor of zoology, Princeton University, delivered an address on "Fitness and Pur-

pose in the Living World" before the Washington Academy of Sciences on December 9.

DR. WALTER S. ADAMS, director of the Mount Wilson Observatory, lectured at Mount Holyoke College on December 8. His subject was "The Stars and their Motions."

DR. HERBERT M. EVANS, of the department of anatomy of the University of California, delivered a lecture on "The Functions of the Anterior Hypophysis" before an open meeting of Sigma Xi at Stanford University on December 3.

DR. E. O. ULRICH, of the U. S. Geological Survey, gave a series of seven lectures on "Eopaleozoic Stratigraphy and Faunas" from December 7 to 14 in New York City. The lectures were sponsored by Columbia University and the New York Academy of Sciences.

DR. JOHN RATHBONE OLIVER, associate professor in the history of medicine in the Johns Hopkins University, delivered on December 14 and 15 two lectures at the Duke University School of Medicine and Hospital on "Medicine from a Historical Standpoint" and on "Greek Medicine and its Development." Dr. J. W. Mayo addressed the staff and students on December 12 on "Endocrinology."

PROFESSOR ARTHUR H. COMPTON, of the University of Chicago, lectured before the Physics Club of Chicago on "Cosmic Rays and Atomic Nuclei" on December 10. This club, which was organized in Chicago last year, now has nearly two hundred members. The officers are: *President,* Dean H. G. Gale; *Vice-president,* Professor Arthur H. Compton; *Secretary,* Burke Smith; *Treasurer,* Dr. Paul E. Klopsteg.

THE seventh American Scientific Congress, which planned to meet in Mexico City in February, 1932, has been postponed to November, 1933.

THE forty-ninth annual meeting of the American Society of Naturalists will be held on December 31 in conjunction with the meetings of the American Association for the Advancement of Science and the associated societies at New Orleans, under the presidency of Dr. S. J. Holmes, professor of zoology in the University of California. In the afternoon there will be a joint session with the Botanical Society of America and the American Society of Zoologists which will be a symposium on "The Biology of Sex." Dr. C. E. Allen, of the University of Wisconsin, will speak on "Sex-inheritance and Sex-determination"; Dr. Emil Witschi, of the University of Iowa, on "The Physiology of Embryonic-Sex-Differentiation," and Dr. H. J. Muller, of the University of Texas, on "Some Genetic Aspects of Sex." The regular annual dinner will be held on December 31 at 7:00 P. M. in the Roosevelt Hotel. It will be followed by the president's address, which will be on "The Changing Biological Effects of Interracial Competition." On December 29 at 8:30 P. M. a biologists' smoker has been arranged by the local committee under the general auspices of the society. All biologists are invited to attend.

FREE public lectures on medical subjects will be given on Sunday afternoons during January, February and March at the Harvard Medical School as follows: January 3—Dr. Philip Bard, "Modern Conceptions of the Brain at Work"; January 10—Dr. R. B. Greenough, "Cancer"; January 17—Dr. C. M. Jones, "Dietary Habits in Relation to Indigestion"; January 24—Dr. M. I. Gregersen, "The Rôle of Water in the Body"; January 31—Dr. H. L. Blumgart, "Pneumonia"; February 7—Dr. R. G. Hoskins, "The Glands of Internal Secretion"; February 14—Dr. T. M. Carpenter, "Alcohol"; February 21—Dr. G. W. Holmes, "What the X-ray Can and Can Not Do"; February 28—Dr. T. D. Jones, "Rheumatic Heart Disease in Children and Adults"; March 6—Dr. L. M. S. Miner, "The White House Conference and Oral Hygiene"; March 13—Dr. F. M. Rackemann, "Asthma, Hay Fever and Allied Conditions"; March 20—Dr. M. N. Smith-Petersen, "Back Ache, Lumbago and Sacro-iliac Troubles."

THE *Journal* of the American Medical Association reports that the second International Congress of Comparative Pathology was held from October 14 to 18 at the Paris School of Medicine. The first congress was held in 1912. The war and various other circumstances intervened to prevent until this year the holding of a second congress. The president of the republic and Mr. Landry, minister of labor, were in attendance. An original idea, carried out by the society that organized the congress, is that its membership consists of physicians, veterinarians and botanists, so as to afford an opportunity to study pathologic problems simultaneously in man, animals and plants. The congress was attended by many foreign scientists, among others, from the United States, Drs. J. R. Mohler, George W. McCoy, Milton J. Rosenau, M. B. Waite, R. L. Jones and V. A. Moore. The topics on the program were: (1) tuberculosis and vaccination, (2) brucellosis in man and in animals, (3) milk and pathogenic agents, (4) mineral deficiencies, (5) ultraviruses and (6) helminthiases.

ACCORDING to *Nature* the annual Congress of the Royal Institute of Public Health will be held in Belfast from May 10 to 15, 1932, under the presidency of the Marquess of Londonderry, chancellor of the Queen's University of Belfast. The inaugural meeting will be held on the morning of May 10, and the scientific work of the congress will be conducted in

the following sections: Section 1, State Medicine and Municipal Hygiene (including Port Sanitation); Section 2, Industrial Hygiene; Section 3, Women and Children and the Public Health; Section 4, Tuberculosis; Section 5, Pathology, Bacteriology and Biochemistry.

WE learn from the London *Times* that the opening ceremony on November 26 of the new building for the Ramsay Memorial Laboratory of Chemical Engineering, University College, London, was performed by Prince George, who unveiled the Ramsay Memorial Tablet. When the laboratory was instituted in 1923, the old parish vestry hall of St. Pancras in Gordon Street was taken over, modified and equipped for temporary use, and this building is incorporated with the new laboratory in the complete scheme of the tribute to the work achieved by Sir William Ramsay during his tenure of the chair of general and inorganic chemistry at University College from 1887 to 1913. The erection of the new building was made possible by a number of leading chemical and chemical plant manufacturers, who subscribed a capital fund of £26,000 and also guaranteed an annual income of £4,000 for a number of years. The new laboratory has been planned to accommodate fifty students and research workers, and is the first of its kind in this country to be designed and erected specifically for chemical engineering teaching. An important feature is an industrial laboratory for the erection, testing and operation of semi-large scale chemical plant.

THE recent report of the London School of Hygiene states that the school has been admitted as a school of the University of London in the faculties of medicine and science. The board has approved an agreement with the Seamen's Hospital Society whereby members of the medical staff of the Hospital for Tropical Diseases form the new Division of Clinical Tropical Medicine which has been established in the school. A university chair has been established in the School for Medical Industrial Psychology. Research work has continued to increase. The carrying out of much research work has been made possible by grants from such bodies as the Medical Research Council, the Department of Scientific and Industrial Research, the Industrial Health Research Board, the Empire Marketing Board, and various government departments. In the past two years £1,250 has been given to the school by Imperial Chemical Industries for the purchase of special equipment in the Division of Biochemistry.

FORMER GOVERNOR ALFRED E. SMITH laid the corner-stone of the Louis Marshall Memorial, the new Science Building at the New York State College of Forestry, Syracuse University, on December 4, 1931. The Board of Trustees of the College of Forestry, Chancellor Charles W. Flint, of Syracuse University; Commissioner of Education Frank P. Graves, Rabbi Benjamin Friedman and Dean Hugh P. Baker participated in the ceremony. The laying of the corner-stone marked the twentieth anniversary of the college and was symbolic of the rapid growth of the institution, the physical properties of which now embrace three large buildings and approximately 7,000 acres of land.

A $400,000 addition to the present quarters of the New York Academy of Medicine, Fifth Avenue and 103rd Street, made necessary by the increased needs and steady expansion of the organization, has been announced. A gift of $350,000 toward the building by Mr. Edward S. Harkness was announced at the same time. The new structure, to be of six stories, will be built on one of the three adjoining lots on East 103d Street and over the auditorium. When the present building was planned seven years ago, provision was made for additional stories to be built as the need arose, and it is expected eventually to continue the building eastward on the two other lots. Mr. Harkness made his gift on the condition that the academy raise a $400,000 endowment. This has already been done and $11,000 has been raised toward the academy's share of the new addition. The façade of the addition will be of stone for the lower three stories, and brick with stone trimmings and corners for the upper three stories. Additional facilities will now be provided for the library, particularly for the care and study of the books on historical medicine; a seminar room for teaching historical medicine; space for the care of portraits and engravings on medical subjects; a larger committee room and exhibition space.

THE Department of Geology of the University of Vermont will install a two component Milne-Shaw seismograph, to be operated in connection with the new Robert Hull Fleming Museum. A grant for this purpose has been made by the National Research Council, and it is hoped to have the instruments in operation by the fall of 1932. Seismograph stations in the northeastern part of North America are in operation at New Haven, Cambridge, Halifax, Ottawa, Buffalo and New York City. It is believed that the addition to this network of a station at Burlington will be of considerable value.

THE British Museum (Natural History) has given £2,000 to the University of Cambridge for the use of the Scott Polar Research Institute. The sum represents part of the unspent balance of a fund which was subscribed to meet the cost of working on the collections and publishing the scientific results of Captain Scott's "Terra Nova" expedition.

THE contributions from the Boyce Thompson Insti-

tute for Plant Research, Yonkers, New York, dealing with all phases of plant research, which formerly were issued only as reprints from other journals, are now published from the institute only and collected in yearly volumes of not less than five hundred pages. Subscribers will also receive reprints of the professional papers dealing usually with practical applications of the research work. Persons carrying on investigations or teaching along the lines discussed will be placed on a mailing list for notices of publications as issued, and furnished with copies on request. Others may purchase such reprints.

DISCUSSION

GAMBUSIA IN FOREIGN LANDS

IN about 1920, apropos of the successful use of Gambusia for the control of mosquito breeding in the extra cantonment zone of a U. S. Army camp in 1918, the International Red Cross made an appeal through diplomatic channels to the Bureau of Fisheries for broodstocks of this fish for Italy and Spain. The shipment that went forward to Italy was a failure, very probably due to improper care of the fish while en route. However, the fish sent to Spain arrived in fairly good condition. A rapid multiplication appears to have taken place, and within a year or so Italy was able to obtain a broodstock from Spain.

In a paper entitled "Recent Developments in the Control of Malaria"[1] given before the National Malaria Committee (conference on malaria at Louisville, Kentucky, November, 1930) by Dr. L. W. Hackett, of the Rockefeller Foundation, who had been stationed in Italy, collaborating with the Italian National Health Department, stated that the introduction of Gambusia into Italy led to unexpected results. He points out that multiplication was unusually rapid and the density of the Gambusia population in some localities apparently now exceeds that of the most favorable places in our Southern states. Standing water in some sections has become fairly clogged with the fish, so much so that the peasants complain that the cattle refuse to drink the water. To illustrate the density of the fish population, Dr. Hackett says:

> From one lime sink in Istria about an acre in extent we took over four million Gambusia for distribution purposes last year without apparently diminishing the number per unit of area. No horizontal vegetation, however thick, can protect anophelene larvae from the fish, large and small, which constantly patrol every square inch of water surface. In the area of about eight square miles which we have had under observation for five years in Istria, the spleen index in a scattered rural population has gone down from 98 per cent. in 1924 to about 10 per cent. in 1930.

(It may be explained here that malaria causes the spleen to become enlarged and the examination of people, especially school children, for enlarged spleens is a common method of determining the prevalence of malaria in a community.)

In regard to the effectiveness of Gambusia for the control of malaria in the area referred to in the preceding paragraph, Dr. Hackett says:

> Acute epidemic malaria is reduced to sporadic cases, and a tuberculosis preventorium for Viennese children can now be operated throughout the year instead of being closed from June to October. There has been no case of malaria among the 300 children in the last two years. Nothing but Gambusia distribution has been done in this area.

Although Gambusia is very effective in standing water, Dr. Hackett points out that in Italy *Anopheles maculipennis,* an efficient vector of malaria, breeds along the edges of running streams, and for the eradication of this mosquito the fish have not been successful, since Gambusia, as is well known, does not frequent running water.

It is understood that Gambusia has been distributed, from the original introduction into Spain, to nearly all countries of Europe from Germany and Austria southward. The results claimed for Gambusia in southern Europe, and especially in Italy, as an eradicator of mosquito larvae far exceed those secured in this country.

The great value of Gambusia as an eradicator of the aquatic stages of the mosquito was first clearly shown in the wide use made of the fish in the extra cantonement zone of Camp Hancock at Augusta, Georgia, in 1918.[2] Other studies were undertaken after this invesitgation was completed and the results published, and the great value of Gambusia as an agent for the control of mosquitoes and malaria became definitely established. Various prior claims were made for Gambusia and other small fish as eradicators of mosquito larvae, but they were not based on well-founded or extensive evidence. In an effort to secure an enemy of the mosquito which will work every day in the year without cost or care, Gam-

[1] *Journal Southern Medical Association,* xxiv: 5, pp. 426–430, May, 1931.

[2] "Fishes in Relation to Mosquito Control in Ponds," by Samuel F. Hildebrand. U. S. Public Health Reports, May 23, 1919, pp. 1113–1128, 3 double pls., 3 figs. Reprint No. 527. Also Appendix IX, Report, U. S. Commissioner of Fisheries, 1918 (1920), 16 pp. Pls. I–VI, 3 figs. Bureau of Fisheries Document No. 874.

busia has been introduced, not only into southern Europe, but also into Palestine, the Philippine Islands (from whence it is reported to have reached China and Japan), the Hawaiian Islands, the West Indies and the Argentine.

Gambusia apparently did not multiply as rapidly or become as numerous in other localities where it was introduced as it did in Italy. However, it generally multiplied and spread. In Palestine alone it appears to have met enemies with which it could not cope successfully. Often Gambusia spread far and wide from the place of introduction, as already indicated, until it has become almost cosmopolitan in the warmer sections of the world.

SAMUEL F. HILDEBRAND

BUREAU OF FISHERIES,
WASHINGTON, D. C.

THE COMMON EARTHWORM AS A SERIOUS ECONOMIC PROBLEM

ORDINARILY the common earthworm is thought of as being a valuable adjunct to the fertility of the soil. Under ordinary conditions this is generally true. However, a condition has come to my notice in which just the reverse is the case.

A few weeks ago a rancher from one of the lower mountain valleys came into my office with the following story. From the main canal, a ditch about a mile and a third in length leads to his ranch. This supply ditch skirts the base of a hill which is largely clothed with scrub oak. Consequently, conditions bordering the ditch are ideal for earthworms, because the soil contains large quantities of humus. Organic matter is abundant.

The whole problem is that the soil bordering the ditch is so riddled with the burrows of earthworms that it is almost impossible to get water through the ditch with which to irrigate the fields of the ranch. The soil bordering the ditch is so porous that the greater part of the water seeps away and is lost. This is a serious condition; and, in years of a scarcity of water, it becomes doubly serious. The rancher was seeking a remedy, for his ranch threatened to become valueless as a result of this condition.

So far as the writer is aware this problem is unique. No precedent was available upon which to base a definite answer to the rancher. However, it was suggested that the ditch be shut down and copper sulphate be used to poison the worms. Copper sulphate can be dropped, a handful about every three or four feet in the standing water in the ditch. When the water shall have all soaked into the soil, the ditch could be opened up again.

If the worms are to be poisoned they must be poisoned by a method that will be harmless to live-stock, since live-stock use the water of the ditch for drinking purposes. It seems that the copper sulphate method is the least likely to be dangerous. Some work done by the writer in former years[1] seems to indicate that this chemical, over a short period of time, will result in no harm to vertebrates.

In the West, in virgin desert soil, so far as the writer is able to determine, earthworms do not occur. They become established only when dry land is brought under irrigation. In some sections of the West, if not most sections, irrigation has not been practiced for very long, comparatively speaking. Consequently, earthworms are just now beginning to be present in really considerable numbers. In fields and pastures generally they are valuable adjuncts to the fertility of the soil; but, in situations such as the above described, they may be a serious pest. In the future they may become more of a pest and a source of serious economic loss. However, it is believed that copper sulphate, a cheap chemical, may be the solution to such problems.

Another solution would be to concrete the supply ditch; but this is an expensive proposition. To build a wooden flume would also be expensive. As a temporary measure, the rancher in question used tarred roofing paper, folded into the ditch, as a relief measure. This latter worked, but it is obviously only a purely temporary way to solve the problem.

The writer has in his own flower garden a short row of sweet peas that it is impossible to water with the hose from the city water supply, when the hose is allowed to run a fair stream with the nozzle placed in a tin tomato can at the head of the row. This is due to the burrows of earthworms draining away all the water. Consequently all watering of these flowers is now done by surface sprinkling.

Water is all-important in the West. Those that are well informed know the careful attention that is given to reclamation and to conservation of the water supply in the western United States. Any waste of water is serious, and a direct economic issue. With regard to the problem as above stated, further research is to be undertaken by this laboratory and it is hoped that a solution may be reached.

C. T. HURST

WESTERN STATE COLLEGE OF COLORADO

CONICAL HAILSTONES

Two interesting descriptions of conical snowflakes have recently appeared in SCIENCE[1], one by Mr. A. D. Moore and one by Mr. W. W. Wagener. It is never easy for an author to feel sure that he has examined all the literature, and it may therefore be worth while to call attention to two papers on a similar subject

[1] C. T. Hurst, "The Effects of Solutions of Copper Sulphate on Ducks," *Arch. Path. and Lab. Med.*, 1926.
[1] A. D. Moore, SCIENCE, 73: 642 (June 12, 1931). Willis W. Wagener, SCIENCE, 74: 414 (October 23, 1931).

written between fifty and sixty years ago by Osborne Reynolds[2].

The papers by Reynolds deal with the manner in which raindrops, snowflakes and hailstones are formed. Concerning the shape of a hailstone he says: "Although to the casual observer hailstones may appear to have no particular shape except that of more or less imperfect spheres, on closer inspection they are seen all to partake more or less of a conical form with a rounded base like a sector of a sphere. In texture they have the appearance of an aggregation of minute particles of ice fitting closely together, but without any crystallization such as that seen in the snowflake—although the surface of the cone is striated, the striae radiating from the vertex." This description is similar to those given by Mr. Moore and Mr. Wagener for the snowflakes which they observed.

Reynolds made some experimental studies in which he obtained imitation hailstones of this shape, but in connection with real hailstones he says: "When found on the ground the hailstones are generally imperfect." Perhaps this imperfection is one reason why the conical form is not observed more frequently.

ARTHUR TABER JONES

SMITH COLLEGE

THE SCHOOL DAYS OF LORENTZ

I AM not sure how generally known it is among scientists in this country that on September 9 last a monument to Hendrik Antoon Lorentz was unveiled in the Sonsbeekpark in Arnhem by Princess Juliana of the Netherlands. In connection with this event, one of Lorentz's early school friends published in the *Haagsche Post* for September 5 some recollections of many years ago. Thinking that a good many readers of SCIENCE may be interested in anecdotes concerning Lorentz, I am sending herewith a free translation of some of the stories told in this article.

I made the acquaintance of Lorentz in the days when the boiling of a kettle of water in the early morning hours was troublesome for the housewife; it could be bought for a penny and a half in one of the neighboring shops.

Soon after I had come to live in the street where Lorentz's father kept a grocery, each of us was sent to fetch hot water. As customary among boys who meet for the first time, we had to make acquaintance by means of a fight; and I was quite ready for a good working out, but did not get that far. Even in his early years Hentje Lorentz was of a peace-loving nature; besides he showed his powers for logical thinking. I can still hear him say, "Don't you think we had better postpone the fight until another time? Fighting is dangerous when you are carrying a kettle of boiling water; for burns leave permanent scars." I had lost my desire to fight and we walked home the best possible friends.

From a later period: One of the three teachers in our school used to lecture occasionally on scientific subjects. For these lectures he needed drawings. Drawing was my one accomplishment. The strange thing happened that I was frequently punished a few days before a lecture was to take place. The punishment consisted of having to draw physical apparatus with white chalk on blue paper. One day there was apparently so much work to be done that one boy could not get it completed in time. To the great astonishment and indignation of the entire school, Lorentz was also punished on that day; no one knew why. So that afternoon, Hentje and I sat bent over large sheets of blue paper. During our work he explained to me the principles underlying the various instruments that we had to draw. To him everything was as clear as crystal; I did not understand much about it and did not know where he got all the information, thinking at first that he was fooling me. All of a sudden our teacher came in, probably having heard a good part of the lecture Lorentz had given me; for he patted him on the back and said: "What brains! There is not very much I can teach you about this subject any more." Among the boys of our acquaintance it was the common conviction that Lorentz knew everything.

From his early manhood: One day I nearly burst with laughing for I met Hentje wearing a full, black beard; he was then nineteen years old. When I expressed my astonishment at this remarkable adornment of his chin, he answered, "I have been appointed teacher in one of the evening schools: this beard will support my prestige." His good-hearted, intelligent eyes showed the same twinkle that always characterized him in boyhood.

ARNOLD DRESDEN

SWARTHMORE COLLEGE

THE WORK OF DR. BASKERVILLE

IN the issue of SCIENCE for October 30, Dr. Carmichael is credited (p. 422) with the following statement concerning the work of the late Dr. Charles Baskerville: "He discovered the chemical elements, carolinium and berzelium."

This is obviously a slip, as no such elements are recognized by chemists. Dr. Baskerville, with whom I had the honor to be associated for four years, did tentatively announce the discovery of substances which he designated as carolinium and berzelium. The announcement was premature, and I am certain that he regretted it. The literature records many similar occurrences, and this does not in any way detract from the high opinion which Dr. Carmichael holds concerning Dr. Baskerville, who was not only a brilliant research chemist but a man whose kindliness and stimulating personality endeared him to his colleagues.

NATHAN VAN PATTEN

STANFORD UNIVERSITY

[2] Osborne Reynolds, Lit. and Phil. Soc. Manchester, Memoirs, Vol. 6 (1876–77 and 1877–78). Reprinted in the Scientific Papers of Osborne Reynolds, Vol. 1: 214, 223.

THE TERM PROTEIN

THE article on "The Revolt of the Biochemists" by me published July 10th in SCIENCE contained the following statement:

In 1860 the term "protein" was introduced by Mulder. . . .

It should read:

In 1839. . . .

The author overlooked the error and is indebted to Professor Lafayette B. Mendel for having called his attention to it.

P. A. LEVENE

SPECIAL CORRESPONDENCE

TWENTY-SEVENTH ANNUAL NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE twenty-seventh annual New England Intercollegiate Geological Excursion was held at Montreal from October 10 to 12. Approximately fifty members attended and the following institutions were represented: Colby, Columbia, Dartmouth, Harvard, Massachusetts Institute of Technology, Massachusetts State College, Massachusetts State Normal School, McGill, Mt. Holyoke, New Hampshire, Tufts, Syracuse, Union, Vermont, Quebec Bureau of Mines, and the Geological Survey of Canada.

On Saturday morning Professor J. J. O'Neil led the party on a trip to the agglomerate on St. Helen's Island. The agglomerate is intrusive into the Utica shale, outcrops of which may be seen on the south end of the island. The fragments in the breccia are sub-angular and consist of Pre-Cambrian gneiss, Potsdam sandstone, Utica shale, and various limestones. The blocks average three inches in diameter, but many are much larger and a few measure scores of feet across. Perhaps the most interesting inclusions are the large blocks of limestone exposed on the northeast end of the island, for they contain Lower Devonian fossils. The ground mass of the agglomerate is highly altered, but contains apatite, perovskite, pyrite, hydronephelite, epidote, abundant carbonates, and doubtful melilite. It is probably alnoite or camptonite.

The afternoon excursion, a trip over Mount Royal on foot, was led by J. J. O'Neil, J. E. Gill and F. F. Osborne. The party climbed up the east slope of the mountain, which rises directly west of McGill University. The first outcrops studied were Trenton limestone cut by a variety of dikes and sills. Higher up on the mountain is a small belt of Utica shale, altered to a compact hornfels. The next stop was at the coarse essexite just below The Lookout. From The Lookout one may make an excellent survey of the St. Lawrence Lowland, which lies about one hundred feet above sea-level. Extending east from Montreal are the Monteregian Hills, the elevations of which vary from 715 feet to 1,755 feet. They are intrusions of alkaline rocks similar to Mount Royal. Still further to the east and southeast are the Green Mountains. Slightly east of south is the Champlain Lowland and somewhat west of south are the Adirondacks.

From The Lookout the party proceeded to the raised beaches on the south side of Mount Royal. These beaches indicate the upper marine limit of the Champlain sea at the close of the Pleistocene; the highest stands at about 575 feet. The last stop was in a large quarry on the west slope of the mountain, where marmorized and squeezed Trenton limestone is intruded by nepheline syenite and basic dikes and sills. It is clear that considerable flowage of the marble has occurred since the intrusion of the dikes and sills, for the latter are crumpled and sheared.

In the evening the group gathered at the McGill Union for brief talks on the trips to be held on Sunday and Monday. Refreshments were then served and the meeting broke up into small groups for informal discussions.

On Sunday Professors J. J. O'Neil, F. F. Osborne and R. P. D. Graham led the main party on an auto trip of one hundred and fifty miles to the Morin anorthosite area in the Laurentian Mountains. Unfortunately it rained most of the day. Nevertheless the party saw a variety of Pre-Cambrian rocks, including Laurentian gneiss, Grenville limestone and Morin anorthosite. At the Ivry mine there is an interesting area of ilmenite and anorthosite. Dr. Osborne considers the ilmenite to be an intrusion into the anorthosite.

On the same day Dr. H. W. McGerrigle guided a small party studying the stratigraphy of the Lower Paleozoic rocks around Montreal. The Island of Montreal and the St. Lawrence Lowland are underlain by Upper Cambrian and Ordovician strata dipping very gently to the southeast and resting upon a Pre-Cambrian basement, which is found in wells 2,500 feet below Montreal. The Potsdam sandstone, Beauharnois dolomite, Lowville limestone, Black River limestone, Chazy limestone, Utica shale and Lorraine shale were all studied.

On Monday the entire party, guided by Dr. H. W. McGerrigle, studied the structure and stratigraphy of

the overthrust sheets of Lower Paleozoic limestones in the vicinity of Philipsburg, P. Q. One stop was along the shore of Mississquoi Bay, where the Champlain thrust may be seen. The Rock River dolomite, of Lower Ozarkian age and belonging to the Philipsburg thrust block, rests on the Utica shale, of Upper Ordovician age and belonging to the foreland. Another stop was at the quarry of the Philipsburg Marble Company, where the Strites Pond and Wallace Creek formations, both of Upper Ozarkian age, may be seen.

Considerable time was spent on the Naylor Ledge and Luke Hill formations, the relations of which have been a subject of controversy[1] between Dr. McGerrigle and Dr. Ulrich. The party agreed with Dr. McGerrigle that the physical evidence disproved Dr. Ulrich's cave hypothesis.

Some of the most interesting exposures were those seen one and a half miles north of St. Armand, for they show the tremendous brecciation at the base of the St. Armand thrust sheet.

The party deeply regretted that illness prevented the attendance of two of its members, Dr. T. H. Clark, of McGill, who had organized the excursion, and Dr. W. G. Foye, faithful secretary of the excursion for many years.

MARLAND BILLINGS
HARVARD UNIVERSITY

REPORTS

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES, 1930–31

THE Research Information Service of the National Research Council, with the cooperation of the registrars of the various American universities, is again able to present information regarding the doctorates in science.

The following data for the academic year 1930–31 supplement the data in SCIENCE 72: 357–358 (1930), where a survey is given of the data for the period 1898–1930.

Detailed data for the year 1930–31, with comparative statistics for the past ten years and with the names of the recipients of the degrees and the titles of the theses, will be found in Reprint and Circular Series numbers 75, 80, 86, 91 and 95. Copies of these may be obtained from the Publication Office, National Research Council, Washington, D. C.

CLARENCE J. WEST
CALLIE HULL

TABLE I

DOCTORATES CONFERRED ACCORDING TO SUBJECTS

	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31
Chemistry	150	185	251	250	257	270	278	312	317	392
Zoology	39	45	42	71	55	70	89	91	102	117
Psychology	32	46	51	51	60	74	66	112	97	105
Physics	57	54	58	59	76	92	78	101	91	93
Botany	37	64	57	69	69	53	61	76	81	81
Mathematics	20	28	32	24	47	46	44	61	75	73
Physiology	18	20	17	17	43	35	28	37	46	46
Agriculture	9	10	11	16	19	19	31	27	29	45
Geology	22	34	41	25	27	42	35	45	63	39
Bacteriology	15	32	12	20	21	20	30	26	27	38
Pathology	27	21	12	5	4	16	31	27	31	26
Engineering	4	5	5	2	11	10	28	34	49	25
Public Health	....	....	....	....	3	4	4	15	8	20
Anatomy	5	10	5	4	11	13	12	15	12	11
Astronomy	4	6	7	3	7	9	3	8	4	11
Anthropology	0	3	3	2	5	3	5	13	6	7
Geography	3	7	3	13	11	14	7	12	17	6
Metallurgy	1	2	2	3	10	4	13	8	4	5
Paleontology	1	2	2	1	7	0	1	2	6	3
Archaeology	0	0	0	0	0	0	0	2	2	2
Med. & Surg.	....	....	....	....	....	....	....	....	4	2
Mineralogy	0	1	1	4	4	2	0	1	3	1
Meteorology	2	0	0	0	0	0	0	2	0	0
Totals	455	575	611	640	748	796	844	1027	1074	1148

[1] H. W. McGerrigle, "Philipsburg Series of Southern Quebec." *Bull. Geol. Soc. America*, 42, 347–348, 1931 (abstract); E. O. Ulrich, "Naylor Ledge, A Marine Limestone of Canadian Age Filling Caverns in Upper Ozarkian Formations" (abstract). *Ibid.*, p. 348.

TABLE II

DOCTORATES CONFERRED ACCORDING TO UNIVERSITIES

	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31
Wisconsin	32	44	41	64	53	55	60	66	86	86
Chicago	61	71	75	59	78	86	70	99	94	82
Ohio State	13	21	20	33	25	30	25	48	50	74
Johns Hopkins	28	58	44	36	50	44	56	62	58	67
Cornell	36	41	60	39	43	62	67	60	80	57
Michigan	20	15	25	15	32	30	52	38	55	55
Yale	22	34	22	41	38	34	38	47	43	53
Columbia	31	58	57	51	49	62	46	61	44	51
Harvard	21	31	35	25	35	42	33	40	40	49
California	24	27	20	31	38	42	37	50	47	48
Minnesota	16	17	23	23	30	29	41	53	53	47
Illinois	28	33	20	32	44	31	36	34	43	45
Iowa State	.....	.....	9	12	14	13	26	28	26	39
Iowa	12	12	16	19	28	24	32	38	28	34
Stanford	7	8	14	15	17	17	17	26	26	28
Calif. Inst.	2	0	9	8	15	8	18	22	18	23
New York	3	10	2	5	7	4	11	13	10	23
Pennsylvania	9	8	12	12	14	27	18	24	26	19
Mass. Inst.	8	11	18	18	13	18	13	20	29	16
Princeton	12	9	17	15	12	18	17	25	22	16
Pittsburgh	7	7	5	8	7	11	13	8	15	15
Cincinnati	5	3	4	7	8	5	1	14	6	13
Northwestern	7	2	6	2	4	6	8	5	8	13
Maryland	0	0	1	5	6	3	6	8	3	12
North Carolina	1	2	1	0	7	3	4	3	6	12
Missouri	4	0	5	4	3	7	2	3	6	9
Virginia	2	1	3	5	5	8	3	5	12	9
Western Reserve	.....	.....	.....	.....	.....	.....	.....	3	5	9
Mich. State	0	0	0	1	4	2	2	6	2	8
Penn. State	.....	.....	.....	.....	.....	1	4	3	3	8
Wash. St. Louis	2	8	2	0	5	7	2	7	7	8
Brown	3	3	3	8	4	4	5	7	9	7
Catholic	0	1	3	3	6	5	8	6	2	7
Indiana	3	5	5	8	7	5	8	9	11	7
Nebraska	2	2	5	7	2	2	3	4	6	7
Purdue	.....	.....	.....	.....	.....	.....	1	0	4	6
Washington	2	0	1	3	1	1	5	8	5	6
Duke	.....	.....	.....	.....	.....	.....	.....	4	4	5
Kansas	0	2	2	4	8	8	5	10	11	5
Rice	1	0	1	2	1	1	3	4	3	5
Rochester	.....	.....	.....	1	0	3	3	0	2	5
Rutgers	.....	.....	.....	.....	2	3	9	4	5	5
Texas	0	1	0	0	1	3	0	7	6	5
Clark	6	8	3	6	7	7	5	11	11	4
Fordham	2	2	0	2	2	1	2	8	6	4
Mass. State	2	1	1	0	1	0	1	1	3	4
Rensselaer	1	0	2	0	2	2	7	3	2	4
St. Louis	.....	.....	.....	.....	.....	2	3	2	3	4
American	.....	.....	.....	.....	3	3	3	1	5	3
George Peabody	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
Geo. Washington	8	13	5	6	4	4	2	5	2	3
Wash. State	.....	.....	.....	.....	.....	.....	.....	.....	1	3
Vanderbilt	.....	.....	.....	.....	.....	.....	2	2	0	3
Colorado	1	1	0	1	3	1	3	3	2	3
Georgetown	.....	.....	.....	.....	.....	.....	.....	1	0	2
Notre Dame	0	1	2	0	0	0	0	1	3	2
Radcliffe	3	3	2	3	3	2	1	2	5	2
Arizona	.....	.....	.....	.....	.....	1	0	0	0	1
Bryn Mawr	7	0	1	1	2	4	0	1	2	1
Marquette	.....	.....	.....	.....	.....	.....	1	0	0	1
N. Y. Forestry	.....	.....	.....	.....	1	1	2	2	0	1
Oregon	.....	.....	.....	.....	1	0	0	0	2	1
Syracuse	1	0	0	0	2	3	2	1	5	1
Boston	0	1	0	0	1	0	0	0	2	0
Tulane	.....	.....	.....	.....	.....	1	2	1	1	0
Totals	455	575	611	640	748	796	844	1027	1074	1148

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF MICRO-MANIPULATORS

SOME interesting variations in the use of the micro-manipulator have induced me to call attention to a point in its historical development. I developed a micro-manipulator in 1905[1] at the University of Pennsylvania for the purpose of dissecting the egg cases of certain animals and orienting the eggs in such a way as to be able to work out the cell lineage; and used the same apparatus for removing chromosomes from eggs. Since these eggs are heavy and would fall to the air-water surface of a hanging drop and be burst by surface tension effects, it was necessary to work from above even though the air-water surface might produce optical distortions while making the observations. A slightly modified micro-manipulator was used in cutting and stimulating protozoa.[2] This work was done entirely independently of the Barber pipette holder which was developed in Kansas simultaneously. I did not hear of the Barber pipette holder until many years later when it was developed by Chambers and others, who found it preferable to work in hanging drops. More recently Richards[3] has developed an instrument for working above the slide and McNeil and Gullberg[4] have described a similar instrument. As to the virtues of these different types, the rack and pinion used by myself gives very rapid manipulation at low powers of the binocular microscope. I used also a micrometer screw, working against a spring. This type gives a slower motion but if it guides a square tube sliding upon a square rod, there is liable to be some lost motion at right angles to the action of the spring unless further springs are used to tighten the bearings. This micrometer arrangement, as well as rack and pinion for rapid motion, is used by Richards. McNeil and Gullberg used the hinged joint as developed by Chambers. It seems possible that the hinged joint acting against a spring may be preferable for movements of short distances. More extensive movements would be complicated by the fact that the movement is in the arc of a circle and not in a straight line.

In my micro-manipulator, movement in the three dimensions was obtained by actuating three knurled heads side by side in the same plane and it was intended to develop reflexes by which movement in any direction could be performed by the fingers of one hand. A long period of education is necessary and it seems probable that a micro-manipulator made on the principle of the pantograph would be preferable in that time required to develop these reflexes would be saved.

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[1] *Biological Bulletin*, 12: 141, 1907.
[2] *Journal of Experimental Zoology*, 6: 87, 1909.
[3] *Journal of Biological Chemistry*, 87: 463, 1930
[4] SCIENCE, 74: 460, 1931.

RAPIDLY RIPENED HAEMATOXYLIN AND ITS USES

KOHL and James[1] have recently presented a rapid method for the ripening of haematoxylin in solutions by exposure to a powerful quartz mercury vapor light. The writer for several years has been using, with considerable success, another method suggested by Miss Ethel Thomas, of the Thomas Biological Supply Company, Charleston, Ill. The method applies principally to the ripening of the haematoxylin for Haidenhain's iron-alum stain, but may be adapted to other haematoxylin stains. It consists of merely adding the haematoxylin crystals (sufficient to make a one half per cent solution) to boiling distilled water. In making the solution the writer has found it best to bring the water to a vigorous boil. The fire is turned off and the crystals added before bubbling completely ceases. A sufficiently large container should be used so that the solution does not overflow during the effervescence accompanying mixing. The solution may be used as soon as cool, but is a little better if permitted to stand a few hours. It changes but little after several weeks in a flask with only a loose cotton plug.

In use, material to be stained is treated according to the usual Haidenhain method, with the exception that the writer uses intensifiers which have proved to be advantageous, although they may be omitted, the results being comparable to the usual ones with this method.

In intensifying the stain the material is removed from the haematoxylin, rinsed in distilled water and destained in 2 per cent, iron-alum until all undesirable precipitates are removed and the intensity of the stain is below that desired in the finished preparation. The material is then rinsed for one to three hours or even longer in two to six changes of distilled water. After the material is thoroughly rinsed to remove all traces of iron-alum, the stain is then intensified by immersion in a weak solution of sodium acid carbonate, magnesium carbonate, or lithium carbonate, until it assumes the desired intensity. In this way a greater degree of differentiation is attained than by the ordinary method. The writer has found lithium carbonate more satisfactory than sodium acid carbonate. Magnesium carbonate has not been used on a sufficient variety of material for its value to be estimated, al-

[1] E. J. Kohl, C. M. James, "A Method for Ripening Haemotoxylin Solutions Rapidly," SCIENCE, 74: 247, 1931.

though where it has been used it has given satisfactory results.

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HEAVY GLASSWARE IN THE LABORATORY

THIS note was suggested by that of Dr. J. Howard Brown who recently described in these columns the use of milk bottles with a crown seal for bacteriological laboratory purposes. In the laboratory with which the writers are connected the replacement of the fragile and expensive laboratory glassware by heavy or commercial products has been constantly increasing. The type commonly known as a prescription bottle, in the 6 oz. and 12 oz. sizes, has been found particularly desirable. The modern heavy glass bottle is so well annealed that it will stand repeated heatings in the autoclave with no clouding of the glass and with a negligible amount of breakage.

Instead of the crown seal, we have used the screw cap seal with excellent results. The screw caps can be obtained with various types of liners, of which the cardboard-waxed paper combination has proved the best. Such caps can be placed on loosely in situations where ventilation is desired. For many purposes an unlined cap is best. It permits of practically no evaporation on long storage and the closure is sufficient to prevent all contamination. The easy removal of the screw cap and its re-use an indefinite number of times is an advantage over the crown seal.

A prescription bottle, which has one side nearly flat, is used in this laboratory for a variety of purposes. It serves admirably for the storage of bacteriological media, for the water used as dilution blanks in quantitative bacteriological work, and in many instances in place of the familiar petri dish. About 15–20 cc of agar is sterilized in the bottle, which is placed with the flat side down for the agar to harden, when the bottle is used in place of a petri dish. When used in the student laboratories in place of the petri dish for isolation purposes or for quantitative work, there is less difficulty from contamination and much less desiccation of the agar than with the petri dish.

The screw cap when placed loosely on the bottle permits of sufficient diffusion of oxygen to support the growth of the obligate aerobic organisms and serves to keep out contamination as well if not better than a cotton plug. In moist situations there is no danger of molds growing through the seal as often occurs with cotton plugs.

These bottles are very satisfactory for the growth of mass cultures of bacteria for the preparation of vaccines and antigens. During the past three years many thousand cultures of the legume-nodule bacteria have been grown and distributed to the farmers of the state in such bottles. Before the adoption of the screw cap, bottles with cork finish were used. The cork-finish bottles were plugged with cotton during the incubation period and this cotton plug was replaced with a paraffined cork for shipment. With the screw-cap bottle, the cap is placed on loosely during the incubation period and then tightened for shipment. The use of the screw cap has materially lessened the labor of preparation and has actually resulted in a lower percentage of contamination. The inoculation of the agar for these cultures is done by a spray process similar to that employed in applying lacquer or paint. An ordinary atomizer with supply pipe dipping into a suspension of the inoculant is supplied with compressed air which passes through a sterile three-foot length of 2 inch iron pipe which is packed with cotton. Two men can easily inoculate 800 bottles an hour with this apparatus.

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SPECIAL ARTICLES

A PRELIMINARY NOTE ON THE SIGNIFICANCE OF THE PHOSPHORUS INTAKE IN THE DIET AND BLOOD PHOSPHORUS CONCENTRATION, IN THE EXPERIMENTAL PRODUCTION OF CARIES-IMMUNITY AND CARIES-SUSCEPTIBILITY IN THE RAT[1]

INTRODUCTION

RECENTLY Hoppert, Webber and Canniff[2] have reported that rats fed stock diets develop caries[3] of the molars at three months of age. The composition of the stock diet as published consists of whole ground corn 60 parts, whole milk powder 30 parts, linseed oil 6 parts, alfalfa 3 parts and sodium chloride 1 part.

When the 60 parts of corn were omitted from the diet and replaced by either 60 parts of oatmeal or 60

[1] The Biochemical Laboratory, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Maryland.

[2] C. A. Hoppert, P. A. Webber and T. L. Canniff, SCIENCE, 74: 77, July 17, 1931.

[3] Dental caries in the rat means a breaking down of tooth structure in the molars of rats resulting in a cavity formation such as has been described in a previous communication (H. Klein, *J. Dental Research*, 11: 151, February, 1931). The use of the term "dental caries in the rat" means exactly what the term implies and does not carry with it any implication or suggestion that such caries in the rat is the same as that known as human dental caries.

parts of that portion of whole ground corn which passes through a sixty-mesh sieve, no caries were observed in the experimental rats. These workers conclude or suggest that the higher incidence of caries on the diet containing 60 parts whole ground corn is due to the impaction in the molars of large particles of corn, resulting in fermentative processes, so giving rise to dissolution of tooth substance. This deleterious effect on the teeth, they report, is prevented by substituting in the diet 60 parts of that portion of whole ground corn which passes through a sixty-mesh screen.

This speculation, namely, that the caries in the rats arises because of particle size, is open to criticism on a number of points. That portion of corn which passes through a sixty-mesh screen has properties which are different from whole ground corn aside from the differences in physical size, and if size of particle was the controlling factor, then oatmeal, which contains large particles, should also cause caries in the diets which they fed. However, oatmeal, as reported by those workers, does not produce caries.

It is the purpose of the present communication to direct attention to the rôle which phosphorus plays in the occurrence of such caries as the above-mentioned writers report.

DISCUSSION

As indicated in the preceding paragraphs, reports on the relation of diet to the incidence of dental caries in rats would indicate that high caries incidence may result from the rats receiving a diet containing large particles of whole ground corn.

If the calcium and phosphorus content of the diets reported by these workers is determined, interesting correlations are established between the occurrence of caries in rats and the level of phosphorus fed, as is indicated in Table I. It will be noted from the table that as the amount of phosphorus is increased in the diet the incidence of caries decreases, the ratio of calcium to phosphorus remaining practically constant.

A study of these phosphorus values seems to indicate that size of particle is not the factor which controls the incidence of caries in the rat, since oatmeal does not produce caries in the proportions as fed by Hoppert, Webber and Canniff. The phosphorus figures, however, indicate that dental caries in the rat appears where phosphorus intake falls to 0.4802 grams per 100 grams of diet where Ca intake is .3424 per cent. Where oatmeal is substituted for the corn, the phosphorus content of the diet is increased to 0.5666 grams per 100 grams of diet, and when sifted corn, which is higher in phosphorus than whole ground corn (see Table II), is substituted for whole ground corn the phosphorus content of the diet is increased to 0.5282 grams per 100 grams of diet. In both of the latter instances the caries incidence is zero, where Ca intake is .4012 and .3490 per cent., respectively.

TABLE I

CALCULATIONS* ON THE DIETS REPORTED BY HOPPERT, WEBBER AND CANNIFF

Diet	Parts	Phosphorus	Calcium	Ca/P ration	Caries	Nature of diet
Whole corn	60	.1740	.0084			
Milk powder	30	.2520	.2760	0.7/1	Per cent.‡ 90–100	Coarse
Alfalfa	3	.0071	.0339			
Linseed meal	6	.0471	.0241			
NaCl	1					
	100	.4802	.3424			
Oatmeal	60	.2604	.0672			
Milk powder	30	.2520	.2760	0.7/1	Per cent.‡ zero	Coarse
Alfalfa	3	.0071	.0339			
Linseed meal	6	.0471	.0241			
NaCl	1					
	100	.5666	.4012			
Corn sifting	60	.2220	.0150†			
Milk powder	30	.2520	.2760	.66/1	Per cent.‡ zero	Fine
Alfalfa	3	.0071	.0339			
Linseed meal	6	.0471	.0241			
NaCl	1					
	100	.5282	.3490			

* Calculations based upon figures given by Forbes.[4]
† This figure is for bolted cornmeal.
‡ This information on percentage incidence supplied through the courtesy of Dr. Hoppert by personal communication.

For the past two years results in the McCollum rat colony have indicated that the level of phosphorus

TABLE II

DETERMINATION OF PHOSPHORUS IN WHOLE CORN AND CORN SIFTINGS WHICH PASS THROUGH NO. 60 SIEVE*

Substance	Sample weight	Treatment	Phosphorus in percentage per 100 grams of substance dried at room temperature
Whole cornmeal*	2.0003	ash	0.295
Hoppert sample	2.0513	ash	0.295
No. 60 sifted corn*	2.0012	ash	0.370
Hoppert sample	2.0014	ash	0.3685

* These samples were kindly supplied by Dr. Hoppert.

[4] E. B. Forbes and M. H. Keith. Technical series, Bull. No. 5, Agricultural Experiment Station, 1914.

in the diet is important in the production and prevention of experimental dental caries in rats. Eighty-eight per cent. of rats fed a diet containing 0.23 grams of phosphorus per 100 grams of diet show dental caries at the end of 140 days of feeding. One hundred and forty rats fed diets containing 0.410 grams of phosphorus per 100 grams of diet show a percentage incidence of caries of 5 per cent.

The studies of McCollum, Simmonds, Park and Shipley, on bone growth and calcification, demonstrated the great importance, for the deposition of calcium salts in the osseous tissues, of certain ratios between these elements. The studies of Howland and Kramer, and others, have demonstrated the dependence of calcification on the inorganic phosphorus content of the blood, and especially on the product of the concentration of calcium and phosphate ions in the blood. We have found that a similar relation exists between blood composition and the incidence of dental caries. Using available data[5] on the composition of rat blood on diets unbalanced in calcium-phosphorus, we have been able to calculate that a critical level of blood phosphorus exists ($10.5 \pm .5$ mg) under which rats develop caries and above which rats are immune from dental caries.

Blood phosphorus concentration is determined in great measure by total calcium, total phosphorus and total vitamin D intake. Therefore the maintenance of a level of blood phosphorus above the caries-immunity level ($10.5 \pm .5$) is dependent upon these three factors. The level of phosphorus intake which will maintain the caries-immune level of blood phosphorus increases with increasing calcium intake and decreases with increasing vitamin D intake.

Summary

(1) Estimations of the phosphorus content of diets reported to produce caries in rats indicate that rations containing 0.4802 grams of phosphorus per 100 grams of diet, or less than 0.4802 grams of phosphorus per 100 grams of diet, tend to induce dental caries in rats if Ca intake is 0.3424 per cent.

(2) Estimations of the phosphorus content of diets reported to produce rats immune to dental caries indicate that such diets contain 0.5282 or more grams of phosphorus per 100 grams of diet and 0.4012 or less grams of calcium per 100 grams of diet.

(3) Experimental evidence is presented which indicates that the level of phosphorus in the diet is an important factor in producing caries-susceptibility and caries-immunity in rats.

(4) We have also found that a relation exists between blood composition (phosphorus) and the incidence of dental caries in rats. Caries arises in rats whose blood phosphorus falls below a critical level (about $10.5 \pm .5$ mg[6] of phosphorus per 100 grams of serum), while those rats whose blood phosphorus concentration is $10.5 \pm .5$ or above are immune from dental caries.

(5) It is indicated that this blood figure is dependent upon the level of phosphorus, calcium and vitamin ingested in the diet.

In a forthcoming paper we shall present the results of an extensive review of the recorded observations of our own and other laboratories on the relation between diet and susceptibility to dental caries in the rat and our conclusions from examining these data in the light of the working hypothesis (blood phosphorus critical level) here presented.

HENRY KLEIN[7]
E. V. MCCOLLUM

[5] Benjamin Kramer and J. Howland. In press.

[6] This figure is obtained by relating the calcium, phosphorus and vitamin D intake and percentage incidence of caries of the Hoppert, Webber and Canniff rats, with the blood calcium and phosphorus values of Kramer and Howland.

[7] Research fellow supported by grants from the American Dental Association and the Dental Staff of the Johns Hopkins Hospital.

ON THE ULTRA-VIOLET PHOTOMICROGRAPHY OF LIVING CELLS

AN important advantage of the ultra-violet microscope in biology is its ability to photograph directly many cell structures which ordinarily are seen only in fixed and stained preparations. In this way one can study these structures without fear that they may be coagulation artifacts. To do this with complete assurance, however, it is often necessary to work with living and not merely with fresh material. All the ultra-violet photographs thus far published have been made with the original microscope of Köhler (Zeiss)[1] or the modification due to Barnard (as built by Beck)[2]. These instruments, though well suited to the photography of fixed preparations, require exposures which are too long for living cells both because of the highly injurious action of the ultra-violet light and because of the loss of fine detail through Brownian movement and protoplasmic streaming.

It has been found that only simple modifications are required to give photographs with the immersion

[1] A. Köhler, *Zeit. f. wiss. Mik.*, 21: 129, 273 (1904); *ibid.*, 24: 360 (1907); A. Köhler and F. Togby, *Arch. f. Augenheilk.*, 99: 263 (1928); E. Grawitz and Grüneberg (photography by A. Köhler), "Die Zellendes menschlichen Blutes im ultraviolettem Licht" (Leipzig, 1906); H. v. Schrötter, *Virch. Arch. f. Path. Anat. u. s. w.*, 183: 343; F. F. Lucas, *Proc. Nat. Acad. Sci.*, 16: 599 (1930); *J. Morph.*, 52: 91 (1931).

[2] J. E. Barnard, *Lancet*, 2: 117 (1925); *J. Roy. Mic. Soc.*, 47: 253 (1926); R. W. G. Wyckoff and A. L. Ter Louw, *J. Exp. Med.*, 54: 449 (1931).

objectives in from $\frac{1}{25}$ to $\frac{1}{5}$ of a second. Resolution approaching the theoretical maximum has been reached in pictures of living cells made under these conditions. We have furthermore observed that many kinds of cells if carefully shielded from all extraneous radiation are seemingly unhurt by the amount of ultra-violet light necessary to photograph them. Consequently it has been possible to prepare serial photographs which show many single cells and simple organisms passing through successive stages in their life histories. As would be expected from the conspicuous absorption of formed chromatin, this "motion picture" procedure has proved especially instructive in studies of cell division.

The microscope used is a Barnard instrument adapted to take Zeiss optics and modified in various minor details of its construction. Reduced exposure and irradiation times have been achieved (1) by employing as source a sufficiently powerful condensed spark discharge (between cadmium electrodes), (2) by refining mechanical features so that the correct focal plane for the ultra-violet light can *always* be reached after applying an empirical correction to the setting for green light and (3) by photographing on fine grained motion picture film at moderate initial magnifications and enlarging from the negatives. It should be remarked that after these modifications ultra-violet photographs can be made with practically the same ease and certainty that attend ordinary photomicrography with visible light.

This apparatus and the "slow motion picture" technique which it makes possible are being applied to the study of a number of biological problems. With A. H. Ebeling photographs[3] have been made of various tissue cells in mitosis. We have also photographed the growth of yeast, several steps in the reduction divisions leading to the production of grasshopper sperm and some stages in the life cycles of typical protozoa. These will be published at a later date, together with a detailed description of the microscope itself.

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ELEMENT 87

THE isolation of element 87, reported in the press on October 15, 1931, offers another opportunity to test the validity of the periodic classification. The accompanying curves indicate certain properties of the alkali elements, and have been extended to cover the properties of element 87 by extrapolation. The values so obtained are subject to the usual objections common to extrapolated figures, but it will be interesting to see how closely they will conform to the observed properties of element 87 when the element has been completely studied.

Figs. 1, 2, 3 and 4 represent, respectively, the

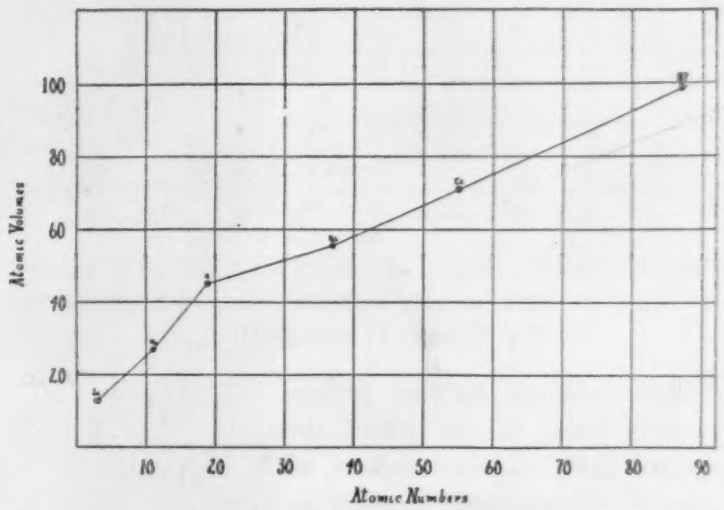

FIG. 1. Atomic volumes of the alkali elements plotted against their atomic numbers, with the value for element 87 extrapolated.

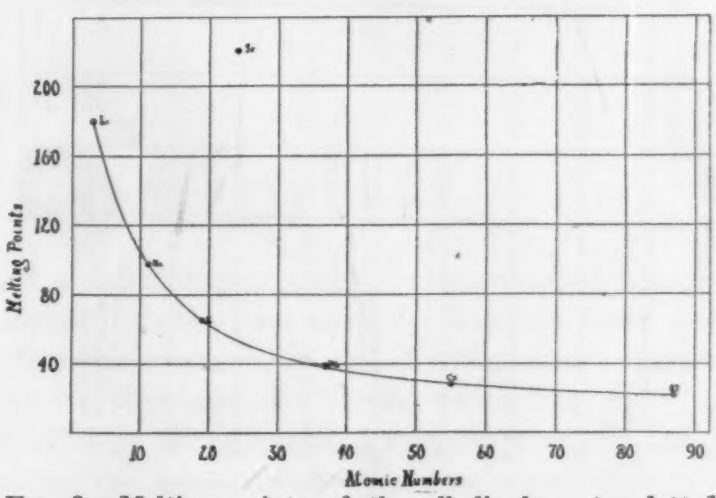

FIG. 2. Melting points of the alkali elements plotted against their atomic numbers, with the value for elements 87 extrapolated.

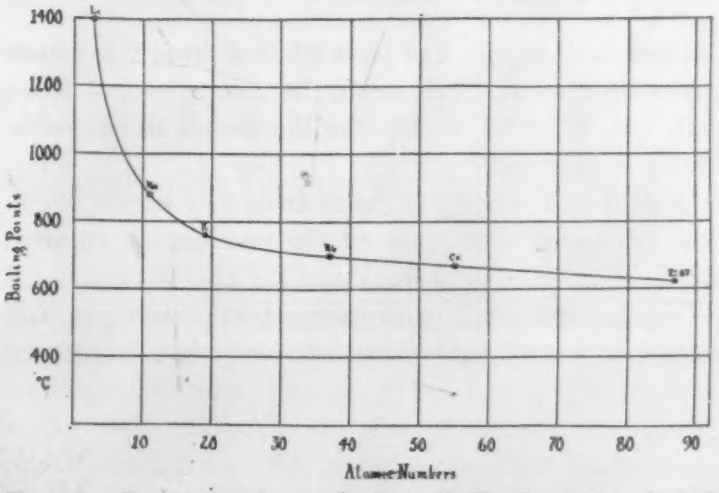

FIG. 3. Boiling points of the alkali elements plotted against atomic numbers, with the value for element 87 extrapolated.

[3] A few of our earliest photographs will appear in a forthcoming number of the *Journal of Morphology*.

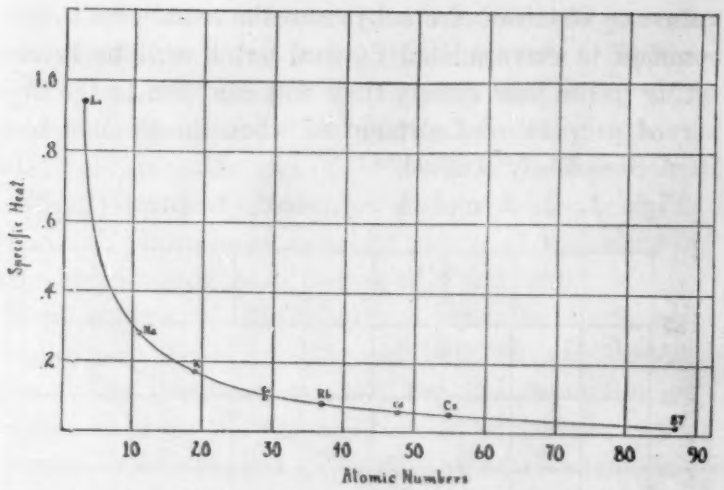

FIG. 4. Specific heats of the alkali elements plotted against their atomic numbers, with the value for element 87 extrapolated.

atomic volumes, melting points, boiling points and specific heats of the alkali elements, when plotted against their atomic numbers, with the value for element 87 extrapolated in each instance.

Fig. 5, representing the wave-lengths of maximum photoelectric sensitiveness of the alkali elements in

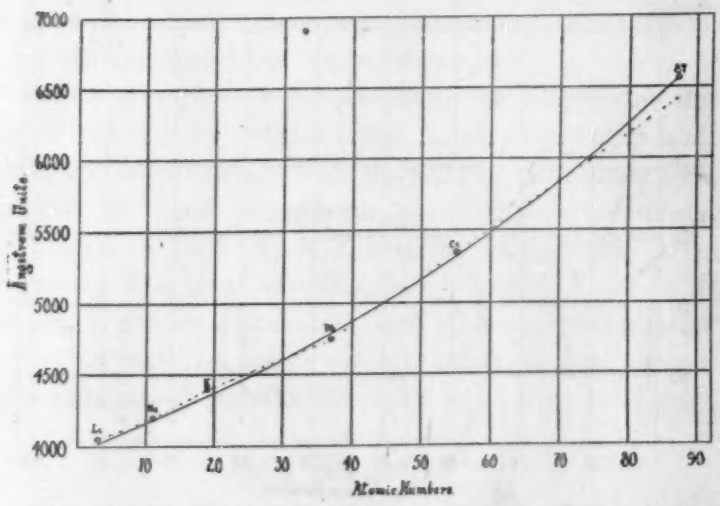

FIG. 5. Wave-lengths of maximum specific photoelectric sensitiveness of the alkali elements in contact with argon, plotted against their atomic numbers, with the value for element 87 extrapolated.

contact with argon, has been plotted from the values given by Miss E. F. Seiler in the *Astrophysical Journal*, Vol. 52, 1920, and is for the metals in comparatively thick layer.

Fig. 6 is a composite curve from two curves showing the sensitivity curve of the caesium on caesium oxide photocell (solid line) and the analogy curve for a similar cell made with element 87, assuming that the same wave-length difference between caesium and element 87 would occur in cell and in maximum photoelectric sensitiveness of curve 5. The curves from which the composite was drawn are from Koller (*J. O. S. A.* and *R. S. I.*) and Zworykin and Wilson ("Photocells and Their Application"). Since the sensitivity peaks broaden and flatten with increasing

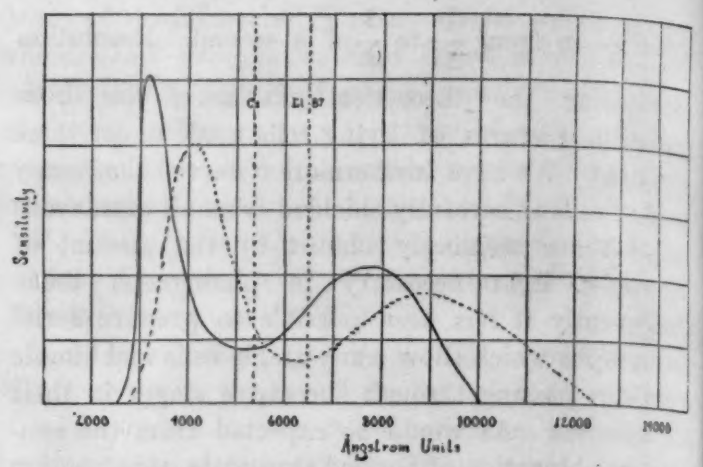

FIG. 6. Photoelectric sensitivity curve of caesium in monatomic layer on caesium oxide; solid line. Analogy curve for element 87; dotted line. The vertical dotted lines represent the wave-lengths of maximum specific photoelectric sensitiveness shown in Fig. 5 for Cs and El 87.

atomic number, a photocell utilizing element 87 might have a considerable sensitivity well into the infra-red.

From the atomic volume, the specific gravity of element 87 may be calculated as approximately 2.2. Its large atomic number makes it probable that several isotopes exist. Since the radioactive degeneration series does not pass through the element, there is no reason to expect that it will be radioactive to any greater degree than the other alkali elements. It should be possible to separate the element from admixture with caesium by differential light ionization in an electrostatic field, since presumably the vapors of the two elements would be ionized at different light frequencies.

C. F. GRAHAM

ALBANY, N. Y.
OCT. 17, 1931.

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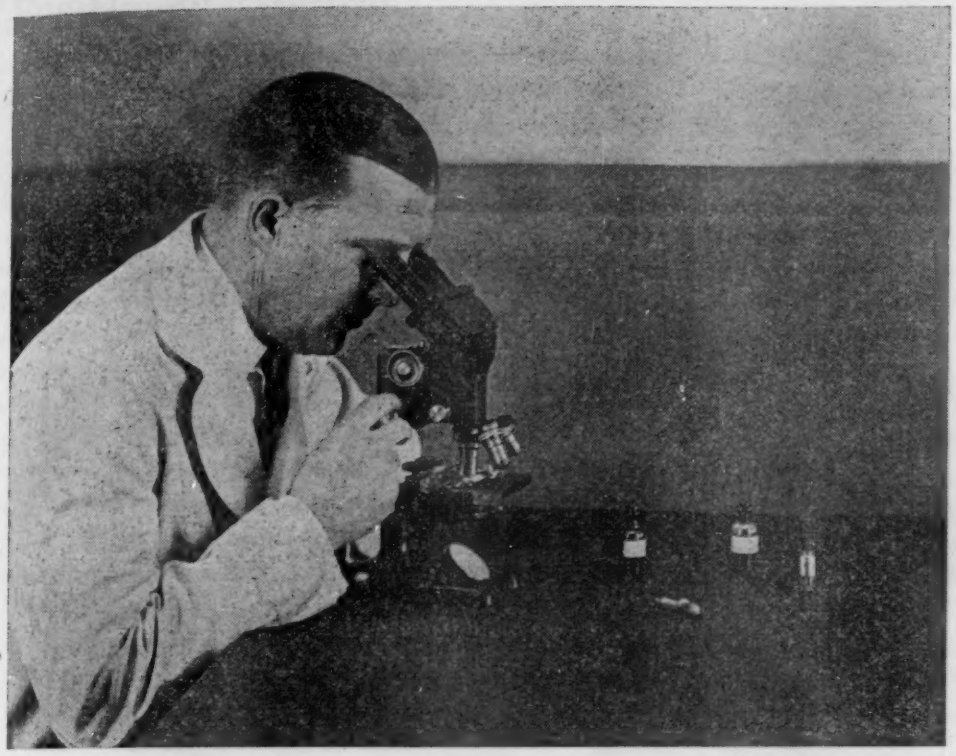

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SCIENCE NEWS

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PROBLEMS OF OCEANOGRAPHY

ALL the creatures man takes from the sea to eat or use, from whales down to shrimps, depend for their life and growth on the behavior of the water, and that in turn depends on such seemingly remote factors as the shining of the sun, the ice of Antarctica, the flow of tropical rivers and the height and length of submerged mountain chains. At the Pasadena meeting of the American Association for the Advancement of Science, Dr. T. Wayland Vaughan, director of the Scripps Institution of Oceanography, outlined the problems confronting investigators in their endeavor to obtain a scientifically and economically useful panoramic view of oceanic life.

The distribution of most of the things needed by plants and animals in the sea depends largely on the circulation of the water, bringing new supplies of mineral nutrients and oxygen up from the uninhabited depths to replace the depleted supplies in the more densely populated surface layers and inshore zones. Circulation in the ocean is influenced by a number of factors, but its primary cause is the same as that of the air circulation that makes weather: the heat of the sun, warming some parts of the earth more than others.

If the ocean covered the whole earth to a uniform depth, Dr. Vaughan said, the surface circulation would be from the warmed equator toward the cold poles, with a return circuit of cold water along the bottom, rising to the surface again at the equator. But actual conditions on the real earth modify this behavior of the "ideal ocean" very greatly. The long north-south stretches of the continental masses get in the way and the rotation of the earth deflects the currents from a true north-and-south line. Continental masses, island chains and submarine ridges get in the way, hindering currents or blocking their most natural courses altogether. Prevailing winds hasten surface currents that flow in the same direction and hinder currents flowing against them. Rainfall, whether directly into the ocean or running off the land as rivers, dilutes the water and makes it lighter; evaporation increases the salt concentration and makes it heavier, so that it tends to sink even if warm. All these different factors working at the same time make the circulation of the world's ocean system a very complicated matter, of which scientists are at present getting only a preliminary notion. Years of intensive study, with the most elaborate equipment on special ships, are still needed.

X-RAYS MOST DESTRUCTIVE TO GROWING CELLS

X-RAYS in sufficient doses are destructive to all kinds of living cells, but they are most destructive to cells that are physiologically young and active. This is one of the basic physiological facts that underlie radiotherapy, according to Dr. Arthur U. Desjardins, of the Mayo Clinic, who spoke at Pasadena. It follows from this principle that tissues that remain "chronically young" respond to X-ray dosages much smaller than those needed for effect on maturer tissues.

The most sensitive of all the cells in the human body are certain classes of white blood corpuscles, and the glands and other tissue masses where these are found most thickly are also very sensitive to the destructive rays. Dr. Desjardins inclines to the opinion that the easy destructibility of these white blood cells is at the bottom of the value of X-ray therapy in certain inflammatory conditions. White blood corpuscles crowd around foci of infection, causing inflammation. The X-rays break them down, releasing the germ-destroying substances they have formed within themselves, and thereby hasten the death of the trouble-causing bacteria.

Certain kinds of tumors and cancers can be treated with X-rays because the cells consituting them are physiologically younger than the surrounding tissues. The diseased growths are therefore destroyed by doses of X-rays that do no appreciable harm to the healthy tissues.

The most sensitive of normal body tissues are the mucous surfaces lining the digestive and certain other cavities. Muscle, bone and nerve tissues are among the most resistant.

SUPER X-RAYS IN THE TREATMENT OF CANCER

DOUBT that the new high voltage X-ray tubes now being developed by physics will effect any great revolution in the treatment of cancer was expressed by Professor R. R. Newell, of the Stanford University School of Medicine, at a symposium given at the meeting of the American Association.

"I do not think," said Professor Newell, "that radium and X-rays will ever prove the solution of the cancer problem. I think the solution must await the discovery of what cancer really is."

Roentgen rays produced at higher voltages will soon become available for clinical use. This means shorter wave-lengths and hence greater penetration. It will be more like radium radiations and of great intensity. Many workers feel that radium produces better results in cancer than do X-rays. Professor Newell pointed out that radium is usually used on smaller masses of tissue and often at a much higher tissue dosage than X-rays.

As we go to shorter wave-lengths, scattering becomes relatively more and more important, so that there comes continually poorer reward for the further increases in voltage. The biologic effect of X-ray has as a first step the acceleration of electrons. These are faster and have a longer path the shorter the X-ray wave-length. Present X-ray tubes provide electrons of such speed that they can not give up all their energy within a single cancer cell. It is hard to see how faster electrons from

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Volume V-1930

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shorter wave-lengths can give any improvement in biologic effect.

The amount of energy in an X-ray treatment is very small. The high-speed electrons produced within the body might number a thousand for every cell. But not all parts of the cell are vulnerable. Several shots must take effect on the vulnerable spots of a single cell before that cell is killed. The chances are that a few cells will escape in this lethal lottery even after very large doses.

SPIROCHETES TO COMBAT PARESIS

PARESIS, now combated in some cases by inoculating the patient with malaria germs, will be subjected to a new attack along a somewhat similar line, but with a harmless relative of the syphilis germ substituted for the malaria organism which sometimes causes considerable suffering and even occasionally death while it casts out the original disease.

At the meeting of the Association on June 16, Dr. Frederick Eberson and William G. Mossman, both of Mount Zion Hospital, San Francisco, told how they have succeeded in growing artificially a harmless spirochete capable of causing a temporary but self-curing fever that operates against paresis much as malaria now does. The syphilis germ, basic cause of paresis, is also a spirochete, so the new treatment is a case of setting cousin against cousin.

The new germ was discovered in ticks in North Africa, and has been used in fever therapy there. However, the technique used in Africa by European doctors has involved the inoculation of guinea-pigs with the germs taken from the ticks, and then the injection of blood from the guinea-pigs into the patients. The method developed in San Francisco eliminates the time loss and uncertainty introduced by the use of guinea-pigs. A very small amount of the pure laboratory culture of spirochetes is used directly on the patients. About a week later they develop a strong fever, which runs its course in about seven days. No medication is necessary to stop it, as is the case with malaria. The fever is self-limiting, and it can be provoked anew by reinoculation as often as is necessary for the benefit of the patient.

Growing the germs in glass vessels in the laboratory also simplifies the hospital's problem of keeping a supply on hand for treatment. Malaria germs have to be obtained from malaria patients, or from blood samples drawn from paresis patients undergoing malaria fever treatment, and such blood samples of course always run the grave chance of carrying fresh syphilitic or other infection with them. But with the spirochetes growing in glass tubes or flasks, and keeping in usable condition for several months in an incubator, the hospital physician is independent of a living source for the germs of the beneficent fevers he desires to use.

FOCUSING OF HEAT RAYS

A COPPER burning mirror which reflects to a focus the rays from an electric arc instead of from the sun has been perfected at the Metallographic Institute, in Stockholm, by Professor C. A. F. Benedicks and Dr. J. Harden. Temperatures of over 3,600 degrees Fahrenheit have been obtained with its aid.

An electric arc between poles of carbon, carrying up to 100 amperes of current, is fixed at one focus of an elliptical mirror 17 inches in diameter, and the heat and light rays are concentrated at another point some distance away. A high temperature can thus be made at this second focus.

Rapid heating and freedom from admixture with foreign substances are advantages of this method of producing high temperatures. A piece of platinum, which requires a temperature of 3,250 degrees centigrade to melt it, was reduced to the molten condition in four and a half minutes. About 25 per cent. of the energy put into the arc is effective in producing the hot spot.

Mirrors have been used to produce high temperatures from the sun's rays throughout history. There is, however, a natural limit to the heating power of such a device, since a mirror of given size can only pick up a certain definite amount of the sun's rays.

Solar furnaces of this kind using parabolic reflectors have recently been perfected at Jena, Germany, by Professor Rudolf Straubel, of the Zeiss Optical Works, and at the new astrophysical laboratory of the California Institute of Technology. Carbon, one of the most refractory of all substances, has been melted in these furnaces at a heat of 5,400 degrees Fahrenheit.

ULTRA-VIOLET LIGHT IN ANTARCTICA

ULTRA-VIOLET light observed on the Antarctic continent by members of the Byrd expedition is very similar in nature to that observed in Washington. The photographs on which this conclusion is based were made at the bottom of the world by Mr. Malcolm P. Hanson, and the findings have been announced jointly by him and Dr. E. O. Hulburt, of the U. S. Naval Research Laboratory.

The rainbows formed by the light of both the sun and also of the moon during the long night of the Antarctic, were measured and found to contain practically the same range of colors. These spectra are of importance to science as indicating that the quantity of ozone in the upper atmosphere does not change with the seasons and is much the same in different parts of the world. The comparison spectra were made with similar equipment by the Naval Research Laboratory in Washington.

The short-wave limit in the ultra-violet of the spectrum was found to be much the same in November and January in Little America as it was in December or January in Washington.

The penetration of the shortest light waves is prevented by the presence of small amounts of ozone, a form of oxygen, in the upper atmosphere. The amount of this gas is astonishingly small in view of its importance for protecting mankind from too severe sunburn. The thickness of the ozone layer that keeps back the shorter waves from penetrating the atmosphere would be only about one eighth of an inch if brought down to the surface of the earth.

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The moon spectra were taken in April and July by the expedition, both observations being made during the Antarctic winter night. The spectrograph was mounted outside on the snow, aimed at the moon and shifted by hand from time to time.

WIND EFFECT ON TREES IMITATED IN LABORATORY

To determine the effect of wind strain on the growth of trees, Dr. W. S. Cooper, of the University of Minnesota department of botany, is carrying on an experiment with Monterey cypress trees. These cypress trees, which have always proved of interest to tourists because of their fantastic shapes, grow native on the rocky coast of California, and are constantly exposed to the wind from the ocean.

How does wind effect the growth of the woody structure of these trees? The natural assumption is that any tree puts on wood in the plane of the wind strain to support itself.

In this experiment, Dr. Cooper has placed thirty-five young Monterey cypress trees in large flower pots. A sliding frame is attached to the trunks of the trees. This is driven by a small motor. The motor causes the frame to slide back and forth, and this makes the trees sway as if in the wind. At the point of contact of the frame and the tree, a rubber insulation is placed to protect the wood from injury. In this manner the trees have swayed nine hours every day for three years.

The results have been contrary to the natural assumption. Dr. Cooper found that until recently, the trees were adding wood and getting thicker at right angles to the strain instead of along the plane of wind pressure. However, in the past few months, a slight change has been taking place. There is evidence to show that in the trunk of each tree, above the point of contact with the frame, the wood is becoming thicker in the plane of the wind strain as was originally expected.

A similar experiment was carried on by G. P. Burns, of the University of Vermont, several years ago. He used white pine trees, however, and conducted the experiment for one year only. His results were the same as Dr. Cooper's in that the trees put on wood at right angles to the strain during that one year.

Dr. Cooper expects to continue his work another two years.

HOW BEARS CAN LEARN

BEARS caught robbing the traps at the Yellowstone fish hatchery recently were "given the works" but not to a fatal degree. It happened this way, according to the park naturalist, Mr. Alfred H. Povah. The traps, placed at the most advantageous spots in a number of creeks, were supposed to catch quantities of fish ready to spawn, and thus supply eggs for restocking purposes. Plenty of fish were seen in the creeks on their way to these spawning grounds, but the traps remained empty. The fish culturists, acting as piscatorial detectives, solved the mystery. Through a few scattered eggs lying along the bottom of the creek just below the trap, they deduced the fact that bears were robbing the traps, and decided to administer an unforgettable lesson.

These traps were inclosed in a fence of wire screening about three feet high. Inside this and about one inch away from it, the hatchery men strung a single strand of heavy copper wire. This was connected with two large storage batteries, hidden in a nearby box, in such a way that when the wire screening was pushed against the copper wire an electric contact was made. The fact that the bear depredator had to stand in water to reach the trap assured a "ground" for the electric current through the animal. This current, while not strong enough to injure the bears, gave them a most unpleasant shock and acted as a positive deterrent against further fish forays.

There was no witness to the chagrin of the first bear to encounter the wire, but within a week after the shocking apparatus was installed the trap was full of fish—and there will now be plenty of eggs for restocking the park's lakes and streams.

ITEMS

THE Kenya Agricultural Department reports that locusts are hatching over an area of seven million acres in the Kenya district of East Africa alone. In addition to this the laying of locust eggs is proceeding over hundreds of miles of dense tropical vegetation in Uganda. The town of Masindi was recently inundated by locusts, forcing all shops to close. In the Kenya district the Agricultural Department is effectively combating the locusts, twelve hundred bags of poisoned bait being issued daily, while there is also spraying and trench trapping. In the Uganda district there is no adequate policy of destruction and great fears are expressed by the neighboring districts regarding the damages anticipated when the eggs mature.

THE appearance of eight pairs of trumpeter swans was reported in Yellowstone National Park during the month of May, which is their nesting period. Conservationists hail this as good news, for these birds are one of the species which are facing extinction under changing conditions, and the Yellowstone is one of the points where it is hoped to check the apparently ebbing tide. Unless the few remaining trumpeter swans in existence can nest and rear their young safely, the species will soon join the dodo and the passenger pigeon.

X-RAYS have been produced by a new method which does not require the use of the usual X-ray tube, by M. G. Reboul, of the Physics Laboratory, Montpellier. The X-rays are produced when electric currents are driven through solids of high electrical resistance with the help of high electrical pressures. In materials that conduct the electric current badly, like the magnesia, alum and yellow oxide of mercury used in these experiments, most of the voltage used is taken up in driving the current across one end of the specimen. At this point where the large fall of voltage occurs, X-rays of low penetration are produced. X-ray photographs of the usual type have been obtained with this arrangement which is simpler than the usual type of apparatus.

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SCIENCE NEWS

Science Service, Washington, D. C.

VARIABLE STARS IN THE LARGE CLOUD OF MAGELLAN

A SUPER-GIANT variable star with light flashing up and down so vigorously that its brightness changes from 12,000 to 33,000 times that of the sun within less than one month has been found in the Large Cloud of Magellan, a distant mass of stars visible in the sky of the southern hemisphere. This star is but one of many super-giant variables in the great star cloud that lies at a distance of ninety thousand light years from the earth. A light year is approximately six trillion miles.

One star out of seventy, among the hundred thousand super-giants in the Large Cloud, has been found to be variable. In 1908 Miss Henrietta S. Leavitt, at the Harvard Observatory, published a list of eight hundred variable stars which she found in the Large Magellanic Cloud. Her discoveries were made by the method of superposing a negative plate of the cloud on a positive, and examining the double images so obtained. The two plates used were taken at different times, and the changes of light of the variables in the interval between made their images look bright on one plate and faint on the other. Thus the pulsating stars were detected. An examination of several such pairs of plates, taken at different intervals of time to show the different periods of variation, resulted in Miss Leavitt's discovery of the large number of variables.

Since Miss Leavitt's time, much work has been done in the discovery of variables in the Milky Way. But until very recently no further hunt was made in the Magellanic Clouds. Within the past few years, however, a number of new photographs of this galaxy have been taken at the South African Station of the Harvard Observatory. These new plates, when recently examined, have yielded a rich harvest of some seven hundred hitherto unknown variable stars in the same regions that contain the earlier discoveries.

The finding of these fifteen hundred variables, together with the probability that there are still others too faint to be detected on the photographic plates, furnishes important information on the structure of galaxies, the distribution in brightness of stars and the distances of the systems that contain them.

One of the outstanding results of this recent survey has been the verification of the important period-luminosity relation found for variable stars. Miss Leavitt noticed, in determining the period of time it took the variables to complete one pulsation cycle, that this period was directly related to the brightness of the star. From her data, and from the data derived from variables in star clusters, Dr. Shapley established the period-luminosity relation by means of which the intrinsic brightness and therefore the distance of the stars can be determined. This relation has done more than any other empirical fact to give us knowledge of the distances of stars and clusters and the structural form of the Milky Way.

It is significant that new periods derived for the Magellanic Cloud variables confirm this relation. Not only in the Large Cloud, but in the Small Cloud of Magellan as well, this powerful tool of the astronomer has found its verification.

CHEAPER HYDROGEN FOR INDUSTRY

CHEAPER methods of making hydrogen from powdered fuel were discussed by Dr. A. Thau, of Berlin, at a joint meeting of the Institute of Fuel and the Institute of Gas Engineers, held recently in London. Apart from its use in domestic gas, industrial hydrogen is in increasing demand for the synthesis of ammonia gas, for the hydrogenation of oils and probably in the near future will be used for the liquefaction of coal. The hydrogen is separated from so-called water-gas which is made by the action of steam on red-hot coal or coke.

Great efforts have been made in recent years to reduce the price of water-gas by utilizing a cheaper fuel, as production costs are comparatively high. At present the process depends on the use of high-class lumpy fuel such as coke or coal which is free from small particles.

Dr. Thau pointed out that the size of the fuel is not of so much importance as evenness of grain, which allows an evenly distributed passage of gas over the whole area of the fuel bed in the "producer," where the chemical action takes place.

The first continuously operated water-gas producer to consume powdered fuels instead of lump fuel, continued Dr. Thau, was designed by Dr. Oswald Heller, of Aussig, Czechoslovakia. Exhaustive trials of the system have been conducted at the Tegel works of the Berlin Gas Company. The producer is of horizontal cylindrical shape and superheated steam is blown into it at seven different places.

The trials have not yet reached a conclusive end, but water-gas can be produced by this process considerably more cheaply than before.

THE CAUSE OF PELLAGRA

EVIDENCE that pellagra, the distressing skin disease which has become known as the hard times disease of southern states, may be caused by alcoholism as well as by improper diet was recently presented to the Medical and Chirurgical Faculty of Maryland by Dr. Thomas R. Boggs, chief physician to the Baltimore City Hospitals.

With Dr. Paul Padget, of Baltimore, Dr. Boggs has studied cases of pellagra at the hospital during two ten-year periods, from 1911 to 1920, inclusive, and from 1921 to 1931. They found that alcohol is playing an increasing part in the development of pellagra.

In the first period, there were 24 cases of the disease. Five of these cases, or 20.8 per cent., were due to excessive use of alcohol. In the second period, however, there were 78 cases of which 35, nearly half, were of alcoholic origin. The increase in the total number in

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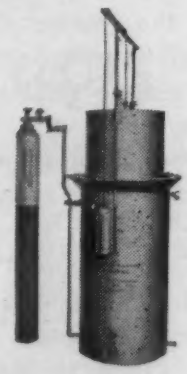

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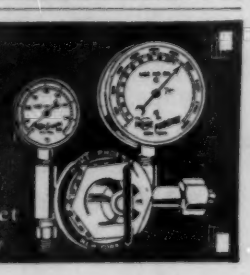

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the second ten-year period corresponds to the increased capacity of the hospital, Dr. Boggs explained, and to the increased total admissions, so that the greater percentage increase of alcoholic cases is truly representative of the alcoholism and not merely of a greater total admission.

This research of Drs. Boggs and Padget suggests possible additional factors in the cause of this disease which has made its appearance rather recently in the United States, although it was known for centuries in Europe. At first it was thought to be caused by a germ and to be contagious. This theory was disproved by studies made by Dr. Joseph Goldberger and his associates of the U. S. Public Health Service. Their investigations showed that it was due to lack of an important factor in the diet which they called vitamin G. This factor is found plentifully in lean meat, milk, eggs and yeast, and in smaller amounts in some vegetables.

This vitamin factor is certainly basic in the cause of the disease, Dr. Boggs said. "But alcohol *per se* or other substances in the present day bootleg supply may play a part."

It may be that the liquor acts to inhibit the vitamins, and so causes the disease, or the disease may occur purely because of the irregular and insufficient food supply of the man on a spree, Dr. Boggs suggested. This last, however, would not apply so well to the regular heavy drinker.

Pellagra is primarily a skin disease with a characteristic eruption and discoloration. It looks somewhat like a severe sunburn, and attacks the hands more severely than any other part of the body. It has also nervous complications and rather serious mental disease develops in advanced cases.

THE HEALTH OF SAVAGES

THE popular theory that savages are healthier than civilized men, chiefly because of their diet, has been well discounted in a report of a three-year research into the physique and health of two African tribes. This prolonged study was made by Dr. J. B. Orr, director of the Rowett Research Institute for Animal Nutrition at Aberdeen, Scotland, and Dr. J. L. Gilks, director of the Medical and Sanitary Service, Kenya, East Africa.

The report, published by the Medical Research Council, is a scientific study of the diets and diseases of two East African tribes, the Masai, famous as lion-hunters, and the Akikuyu.

These two tribes, although they live according to nature, are not the healthy, robust creatures the native free from civilization's restrictions is generally supposed to be. They have not balanced their food ration. The Akikuyu diet is too rich in carbohydrate and deficient in calcium, while the Masai have insufficient carbohydrate and cellulose vegetables, that is, not enough roughage. The report points out that improvement might be brought about by increasing the use of green vegetables by both tribes, and of milk by the Akikuyu.

A special study was made of the Akikuyu dinner table. It was found that the ordinary meal consists of a thick porridge called "irio" and a gruel called "ucuru," but the women make a special "irio" of their own, which no males over five years of age eat. In this dish, green leaves and salt are added to the ordinary maize, legumes and plantains. The women have a virtual monopoly of green leaves, and also have a weakness for edible earths and for ashes.

Analysis of samples of these native dishes at the Rowett Research Institute showed that the ordinary "irio" and "ucuru" were very low in the mineral elements vital to nutrition, particularly in calcium.

On the other hand, the leaves eaten by the women were very rich in certain minerals, the percentage of calcium in some being higher than that previously recorded in any natural foodstuff. Some of the edible earths were rich in iron, and one special delicacy, a red millet, which is eaten before and after childbirth, contained fourteen times as much calcium and sixteen times as much manganese as ordinary millet.

The significance of these discoveries lies in the effect which the larger "iron-ration" eaten by the women has upon their health, as they are admittedly superior to the men in physique, and appear to be more healthy and freer from pulmonary diseases. One of the native chiefs was asked why the men did not follow the example of their wives and eat green leaves. "Such food prevents them from being swift of foot if defeated in battle by the Masai," he replied.

THE RECOGNITION OF SCIENTIFIC DISCOVERIES

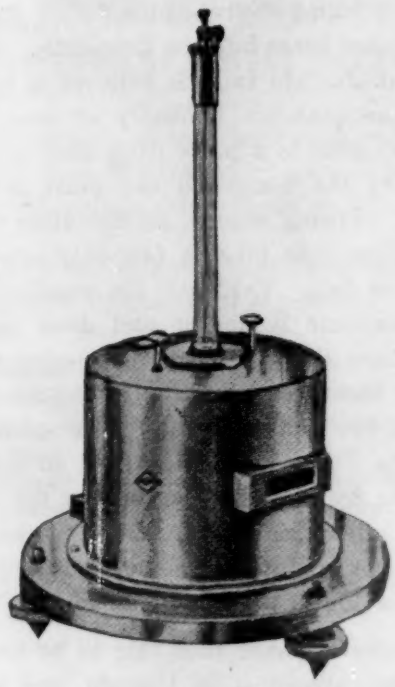
A GREAT scientist must also be a great salesman if he wants his discovery to be understood and welcomed in his own time. This idea was advanced at the dedication of the Science Hall of the University of Southern California by Professor Wilder D. Bancroft, of Cornell University.

There is more danger of a great new idea's not being accepted than most people realize, said Professor Bancroft. To be received by the multitude of non-discoverers an idea must obviously be acceptable to them in some way or other. This is one of the most fundamental of all questions involved in human progress and at the same time one of the most difficult.

Quoting a great chemist of last century, Professor Bancroft continued, " 'When the prospective genius has done his great work and has communicated it to the world, one likes to think that he can go quietly to bed and wake up famous the next morning.' This, however, hardly ever happens. Very often the work of getting the new idea accepted is scarcely less than that of originating it.

"In many cases the man who has had the idea is not able to get it accepted and this task falls to the lot of another man who may be less clever, but who speaks a language which makes the world conscious of the treasure which it had been offered in obscure words."

Professor Bancroft said that a new discovery is accepted for one of four reasons. It is accepted because it is made by a man of recognized authority or of per-



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sonal magnetism, because it clears up points over which people have puzzled or because it shows what to do next, because of extensive proofs, or because the results are useful or striking.

If a good idea falls flat it is customary to say that the time was not ripe for it. However, it may be possible in some cases to change the temper of the time or as Professor Bancroft said, to "ripen time." "To ripen time we must establish our view by many proofs; we must discover something for which the world is ready; we must educate the world up to our discovery, or somebody else must educate the world for us."

Dr. Bancroft gave many examples to show that new discoveries had often to wait many years before being accepted by scientific men. Avogadro's law, fundamental in modern chemistry, was formulated in 1813 but had to wait over 40 years before trained chemists really understood and believed in it.

A Russian chemist, Lomonossoff, who lived from 1711 to 1765, had views on oxidation, the wave theory of light and the nature of heat that were from 50 to 100 years in advance of his time. Thus credit for his discoveries, which were many, has been distributed among others. Even to-day his name is little known. It is only a few years since his work was rediscovered and reprinted by a fellow-countryman.

"One can not count on having some one else exploit one's discoveries and the worker in pure science will not and should not limit himself to discovering only those things which the world knows that it wants," concluded Professor Bancroft. "Consequently, he must make up his mind to sell himself to the scientific world. . . . Since the greatest discoveries are likely to be the ones for which the world is least ready, we see that the greatest scientific men should really be super-salesmen."

ITEMS

FIFTEEN icebergs, instead of the usual scores or even hundreds, represent the total crop of 1931 in the waters off the northern coast of North America. Dr. Olav Mosby, Norwegian oceanographer now cruising on the U. S. S. *General Greene* to study icebergs in the waters off Newfoundland, has wired *Science Service* that during May only thirteen irebergs had been seen south of Newfoundland, and only one during each of the preceding two months. None of this scanty crop of floating ice-mountains got as far south as the usual steamer tracks. The farthest south was the forty-sixth parallel of latitude, which is fully three degrees north of the normal limit for this time of year. Dr. Mosby found also that the Labrador current is still weak and has brought down less than the normal quantity of cold water.

THAT recent earthquakes in southeastern California follow the passing of the moon overhead was announced to the meeting of the Seismological Society of America by Dr. Maxwell W. Allen, of Sanger, Calif. These earthquake shocks are not caused by the moon and they would have occurred anyway without its assistance. But in far more cases than chance would allow, the earthquake occurs when the moon is in a certain part of the sky. The critical time seems to be about five hours after the moon has reached its highest point in the sky and again some twelve hours later. Earthquakes do occur at other times but less frequently. Some weak part of the San Jacinto fault is believed to be the origin of these minor quakes. Probably at some relatively shallow depth, there is a point little able to resist the forces created by the moon and the quake is "set off" at this point. Strong shocks, on the other hand, according to Dr. Allen, take place a few days after the moon is either new or full. Evidently the sensitive spot of the crust in this case is deeper and more plastic. Forces can thus deform this layer without causing a disturbance. Only by the repeated action of the tidal pull from day to day is the quake set off. The moon may produce these effects either by a direct pull on the surface of the earth or by pilling up waters in the upper part of the Gulf of California, in Dr. Allen's opinion. He explained that it is not yet known whether the trigger effect on the quakes is due to water tides or to earth tides.

SIAM'S sacred white elephant bids fair to be matched with a sacred white rhinoceros in Uganda, one of the great British protectorates in Africa. The protection given this rare and diminishing species has become so absolute and exacting that even photographers going into the district to photograph the great beasts are required to obtain a license, and are warned not to do anything to frighten or enrage them. Infractions of this rule are punishable by a fine of a hundred pounds or imprisonment for six months. If the offense is repeated the fine goes up to £250 and the jail sentence is trebled. Any one killing or wounding a white rhinoceros forfeits his hunting license.

DIRECT rays of the sun are being utilized by forest service entomologists in exterminating destructive beetles which in recent years have killed millions of board feet of timber near Diamond Lake, just north of Crater Lake National Park. The treatment is applied by felling beetled-infested trees and exposing the trunks to the sun in forest clearings. "At this time of the year, air temperatures of 85 degrees in the direct sunlight will raise the temperature of the infested bark to 130 degrees Fahrenheit," according to A. J. Jaenicke, federal entomologist in charge of the work. "This," he says, "literally cooks the beetles to death."

THE pencil wood supply near large factories is practically exhausted and the industry is now investigating the possibility of utilizing Alaska red cedar, the finest-grained wood of the Northwest. Cedar wood intended for lead pencils must be soft, light, yet strong, close and straight-grained and free from defects. The older the tree the better pencil wood it makes. The wood from the heart of aged logs that have lain in deep woods for years makes admirable pencil material. A possible substitute for cedar in lead pencils is Pacific coast myrtle. Its wood is light, straight-grained, well-scented and of good color. Both cedar and myrtle woods are immune to the effects of quick climate changes.

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SCIENCE NEWS

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THE WAVE LENGTH OF ATOMS

AT the Bartol Research Foundation, at Swarthmore, Pennsylvania, a stream of atoms has been made to behave like immaterial waves scattered in many directions.

Dr. Thomas H. Johnson, of the Franklin Institute, Philadelphia, has fired a stream of hydrogen atoms at the surface of a crystal of lithium fluoride and by observing the spread of the reflected atoms has found the wave length of the atoms and has learned how the network of atoms on the crystal surface is fitted together.

This discovery is the latest development in the great new branch of physics inaugurated in 1924 by the French nobleman and scientist, Prince Louis de Broglie, who first proposed to give matter the properties of waves. The revolutionary new wave mechanics, which threw many of the cherished notions of the nineteenth century overboard, has grown with amazing speed since its birth at the hands of de Broglie and now is the main weapon of investigators in attacking the intricate problems of the structure of the atom.

The present experiments confirm these new theories of the wave-like behavior of all matter. The beam of atoms reacts with the surface in much the same way as would a beam of light waves. It is, in scientists' language, "diffracted."

This sort of thing was never suspected until the arrival of the quantum theory in physics on which, for instance, television and the talking movies depend. A beam of light was supposed to consist of waves. On the other hand, atoms or electrons in motion seemed to be like bullets.

This simplicity is all confused now. Light entering a photoelectric cell seems to act like a stream of particles, and it has been shown by two physicists of the Bell Telephone Laboratories, Drs. C. J. Davisson and L. H. Germer, that even electrons, those lumps of negative electricity which make the electric current, might, under special circumstances, behave like waves. These inconsistencies have led physicists to think that the distinction between lumpy particles and smooth tenuous waves was not so clear as they had thought.

Dr. Johnson's present experiments supply the last link in this chain of contradictions. He found that even atoms of hydrogen, apparently the most material of things, may become immaterial enought to act like waves breaking on a rocky shore when they are fired at the regular lattice work of a crystal. The atom waves are very short; that is, the distance from crest to crest of the waves is only about the diameter of an atom, one hundred millionth of an inch.

X-rays have been used for some time to explore the interior of crystals. The shortness of the new atom waves enables them to do still more and disclose even the small irregularities of the surface.

Before this work a crystal was regarded as made up like a super chess board with some four thousand million million squares on the square inch. Dr. Johnson's work shows that minute cracks break up the large board into a multitude of small ones having some four hundred squares on each. Enough atomic chess boards to take care of a gigantic chess match in which every member of the human race engaged are to be found on an area of about one ten-thousandth of a square inch of crystal.

COMET DISCOVERED ON 1902 PHOTOGRAPHS

THE remarkable Schwassmann-Wachmann comet which varies in brightness and remains in view of the earth throughout its circumnavigating of the sun existed at least twenty-five years before its discovery by the German astronomers at Hamburg in 1927.

Leland E. Cunningham, of Harvard College Observatory, has discovered that a comet found by Dr. Karl Reinmuth, of Heidelberg Observatory, on photographic plates made in 1902 is the same as the now famous Schwassmann-Wachmann comet. The official announcement of identity of the two objects will be contained in Harvard College Observatory announcement, 159, now being mailed to astronomers throughout the world.

The famous comet that is named after its two German discoverers is unusual because it has a nearly circular orbit, remains more than half a billion miles from the sun traveling between the orbits of Jupiter and Saturn, and undergoes sudden variations in brightness.

For a comet it has an unusual behavior in its brightness. Professor George van Biesbroeck, at Yerkes Observatory, finds that it changes its brightness suddenly, and early this year it had one peculiar outburst which changed its brightness a hundredfold within a few days.

Never is this comet seen with naked eyes. At its brightest it is only twelfth magnitude, which means that only powerful telescopes can catch it. This Schwassmann-Wachmann comet is also probably the first comet that is observable all the way around its orbit.

Although the comet was first discovered in 1927, it has been given the designation of 1925 II (Roman numeral two) in astronomical literature. This is because it was nearest the sun in 1925 and it was the second comet of that year to pass perihelion.

RADIATION FROM VITAMINS

Two of the vitamins, A and B, apparently give off some kind of a radiation that will affect the emulsion on a photographic plate in the same way that light and X-rays do. This is indicated by experiments performed by Sophie Botcharsky, of London, and Anna Foeringer, of Paris.

In the British scientific journal, *Nature*, they report as follows: "Photographic plates were covered with aluminum foil and letters were cut out of the foil covering the glass side. Extracts of vitamins A and B, biologically tested, were used to paint the letters VA and

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JUNE 13

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EDUCATIONAL REVIEW

Edited by WILLIAM McANDREW

Editorial Comment.
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VB on the glass side. The vitamin A used was ether extract of dried ox-liver, the solvent being removed in nitrogen. Vitamin B was water extract of purified brewers' yeast. The plates, wrapped in black paper, were left for three days; on development, clear images of the letters were obtained.

"To confirm the results, vitamins A and B were sealed in two separate glass tubes, and the experiment was repeated. Very sharp images were again obtained.

"An extract of vitamin A prepared in a Paris research laboratory was investigated in the same way. It also gave positive results.

"Vitamins destroyed but not carbonized did not affect the plates.

"Two solutions, one ten times stronger than the other, of vitamin A in paraffin oil and vitamin B in water, were compared. The plates showed clearly difference in strength. Control experiments of pure solvents gave unfogged plates.

"It is interesting to note that the effect of vitamin B is similar to that of vitamin A, although the two vitamins are of different origin.

"The experiments were repeated several times, and the same definite effect was present. We are proceeding with our research into these effects."

ELECTRICITY FROM THE TIDES

AN experimental power plant which generates electricity continuously from the ebb and flow of the tides has been constructed and successfully operated at the Avonmouth Docks, in the Bristol Channel.

The plant is the invention of Paul Shishkoff, formerly a Russian subject. It includes a novel method of storing the excess power produced at low tide so that a continuous supply of energy can be obtained at all times. The capacity of the installation is three hundred horsepower.

The sea fills up the dock at high tide. As the tide recedes, water from the high level is run through a pipe to drive a water wheel of standard type. The vertical shaft of this wheel is connected to an alternating current generator which produces electric power.

The difference in water level between the inside and outside of the dock varies from seven feet at high tide to 32 feet at low tide, and when this working head of water is at its greatest more power is produced than the generator can take care of.

At these times a water brake on the shaft with the driving wheel is used to store the excess power. This brake really churns water and thus heats it. The water, heated to 390 degrees Fahrenheit, enters a large vessel called an "accumulator," where it is kept under 200 pounds per square inch pressure until the direct power supply from the water wheel falls off.

The superheated water from the accumulator is now released under reduced pressure to form steam. Heat necessary to produce vaporization is derived from the remaining water, which is slightly reduced in temperature.

This steam drives a turbine connected to a generator. Thus power is available even when the low-tide level can not be used directly. The exhaust steam from the turbine is condensed and returned to the brake where it is again heated at times of maximum power.

The pumping of water to a higher level by means of excess power is the only other practicable means of storing power. Apart from the use of this new scheme in connection with the tides, it is of great interest in that it provides possible answer to the important engineering problem of storage.

Mr. Shishkoff has proposed that a larger model of his system be constructed in the Severn River. An artificial basin of 12½ square miles is planned to make available enough water for generating 160,000 kilowatts at peak load. This development, it is claimed, would not interfere with the tidal flow or with navigation in the Severn.

It is claimed that electricity at forty-four hundredths of a cent per kilowatt-hour could be made by such an installation, which compares favorably with a coal-burning plant of the same capacity.

A rival scheme designed by a Swiss engineer, Huguenin, would require the building of a large dam and would use two-way flow turbines. It is still in the theoretical stage.

The Bay of Fundy, Nova Scotia, has a difference in tide level of 35 feet. A large power scheme for this site involving the building of a big dam has been worked out in considerable detail. A similar project for Aberwrack, near Brest, France, has been approved by the French Government and is in process of construction.

DENTAL DISEASE CONTROLLED BY DIET

DENTAL caries, a disease in which the teeth decay and cavities form, can be controlled by suitable diet, it appears from the report to the American Dental Association of Dr. R. W. Bunting, Dr. Philip Jay and Dr. Dorothy Hard, of the University of Michigan School of Dentistry.

These investigators carried on an experiment in caries control for one year in three large groups of children in public schools and orphanages. The children were given a varied diet, fortified by one quart of milk and some green vegetables and fruit for each child every day. They were not given either cod liver oil or viosterol. They had no sugar on cereals or in beverages, very little sweetened preserves and pastries, and little or no candy.

"The elimination of sugar was made on the assumption that the average child consumes more carbohydrate in this form than is required and that such over-consumption of sugar perverts the appetite for other necessary food factors, thus unbalancing the diet." In addition to the diet, a mouth wash of hexylresorcinol diluted with three parts of water was used daily.

At the beginning of the experiment, the teeth were carefully examined and their condition recorded, with actual drawings of the approximate size and location of all cavities and fillings. At the end of the year, the children were examined again in the same manner, and the results of the two examinations compared.

In three groups in which fairly adequate diets were

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provided, active caries were almost negligible and old cavities were quite uniformly arrested. In two groups in which the diets were not carefully planned, the dental disease was very rapid and active in its course. Further similar studies are planned.

THE INFORMATION OF KINDERGARTEN CHILDREN

A HOT political campaign may get grown-ups terribly excited, but it leaves no impression on children of kindergarten age. When the question "Who is Herbert Hoover?" was put to 100 youngsters between five and six years old, not one could answer. Only one knew who Al Smith is. Yet 87 knew what Lindgergh did and Andy Gump was familiar to 74.

These questions were asked in the course of an investigation conducted by Cathryn A. Probst, at the Institute of Child Welfare of the University of Minnesota to find out how much information, and what kind, is the equipment of the child when he enters the first grade of the public school. The results of her study are published in the current issue of *Child Development*.

Despite the rarity of the horse, every one of the children knew that this animal has four legs. The only other questions which no one missed were "What do we use to cut cloth?" "What do you use to cut meat?" and "What do you use a saw for?" Among the other easy questions were those dealing with the seasons of the year, the functions of the dentist and barber, the colors of the flag, and a few of the simplest natural history questions.

Some of the errors were amusing. According to some of the children, a carpenter fixes carpet sweepers; buttermilk is made by butterflies; baking powder is used by ladies on their faces; a plumber pulls out plums, and a man who raises corn or wheat is called a bachelor.

It was rather surprising that only 11 knew what Cinderella's coach was made of, and only 9 knew how many wings a butterfly has.

The occupation of the parents made a great difference in the range of information of the children. On only 7 out of the total of 132 questions did the children of semi-skilled and unskilled laborers excel the children of the more trained occupational groups. These questions included "How many eggs in half a dozen?" "What time is it at noon?" "Who is Dempsey?" "How many horns has a cow?" "How many wings has a butterfly?" "What must you not do in tin-tin? (a game)" and "What must you have to play anty-over?"

Boys were better than girls on all types of questions except those dealing with weather and other natural phenomena.

ITEMS

M. ROSENBLOOM, of the Faculty of Sciences of the University of Paris, has found that the particles from some radioactive atoms like radium consist of distinct groups of equal speeds, the speeds of the groups, however, being different. This gives a means of finding out the structure of the small core of the atom, which is the present goal of atomic physical research. The most typical mode of disintegration of radium and other radioactive bodies is by the expulsion of alpha particles with great velocity and energy. These are helium atom cores. It has long been known that from a given element the helium particles appear to be expelled with the same characteristic speed. This indicates that the alpha particle occupies a certain definite energy level in the atom which is defined by so-called quantum conditions. In the radioactive thorium-C atom, which has now been found to consist of a number of distinct groups each characterized by a certain speed, Lord Rutherford has pointed out, these groups disclose the existence of several energy levels within the nucleus. Ordinary electromagnets are not able to cause sufficient deflection but with the assistance of the magnet Professor Aimé A. Cotton, at the Sorbonne, can bend the alpha particles round in a semi-circle and separate them out.

AN electric lamp converting current into light completely without producing heat at the same time has been operated in a laboratory experiment by Dr. M. Pirani, director of the Society for the Study of Electric Lighting in Berlin. The new tube is not suitable, however, for domestic or industrial lighting. The invention of a "cold light" that would avoid wasting 80 to 90 per cent. of the current as heat, as in the ordinary lamp, has been the goal of physicists and engineers for years. Dr. Pirani's new light, however, is actually heated by a furnace on the outside. The tube is a modification of the gas discharge tubes used by neon lights in advertising and recently brought to a 30 per cent. efficiency by Dr. Pirani. He now finds that if the losses due to the higher temperature of the discharge tube are taken care of by a separate source of energy, that 370 lumens or light units can be obtained per watt of electricity. This represents a completely heatless conversion of electricity into light energy.

COMMON ordinary soapsuds, particularly hot ones, are extremely good agents for killing germs, Dr. John E. Walker, of Opelika, Alabama, has reported to the recent meeting at Chicago of the American Medical Association. The results of his own and other investigations show that the germs of pneumonia, meningitis, diphtheria, syphilis, gonorrhea, influenza and the streptococcus germ were all killed in about two minutes by comparatively weak solutions of soap in cool water. The soapsuds compared favorably with many newly-synthesized chemicals in germ-killing power. The brand of soap apparently made no difference, brown laundry soap, floating white soap, perfumed toilet soap, coconut oil and olive oil soaps and soap made according to the standards of the U. S. Pharmacopoeia were equally effective. "When properly used for cleaning the hands or for washing out eating utensils, soaps are undoubtedly potent factors in preventing the spread of diseases due to these organisms." However, the germ of typhoid fever and the staphylococcus organisms are not destroyed by soaps.

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SCIENCE NEWS

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NEW CHECK ON THE EARTH'S AGE

NEW measurements on a very old mineral have given the possibility of a new accurate determination of the time since the molten earth cooled sufficiently to form a solid crust. This new glimpse into the past of the earth comes as a result of the work of Dr. A. von Grosse and Dr. J. D. Kurbatow, working at the Institute of Technology in Berlin.

That the earth is at least eighteen hundred million years old is one of the conclusions recently reached as a result of studies in physics and geology by the Committee of the National Research Council. A revision of previous calculations may be necessary, however, since the recent work. Physicists have grown accustomed to changing their estimates on this problem from time to time. During the last century, before the discovery of the radioactive atoms like radium, Lord Kelvin was quite sure that the sun even could not be older than fifty million years; and of course the earth had to be younger than the sun.

The new research in Berlin indicates that the ratio of actinium to radium is four per cent. in the "Wilberforce uranite" examined. This fact gives a new check-up on the reliability of the most accurate clocks used by physicists in solving this problem. Those clocks are provided by the unchanging disintegration of heavy radioactive atoms into lighter atoms.

As this process has been going on for millions of years at the same rate as now, it is possible by measuring the amount of lighter atoms formed to know how long the break-up has been going on. These lighter atoms are very similar in nature to lead, and can not be distinguished from it by ordinary chemical means. Separate clocks are given us by three different chains of elements which start from uranium, thorium and the yet-unknown parent of proto-actinium. The end of the uranium chain is radium "G," of the actinium chain is actinium "D." By measuring the amounts of lead, uranium and thorium and the relative amounts of radium G and actinium D two independent checks on the age of the earth can be obtained from the radium clock.

The new figure given for the actinium-radium ratio is different from that accepted by the National Research Council Committee: three per cent. At present the greatest possible age for our planet is believed to be 3,000 million years.

BALL LIGHTNING

BALL lightning, one of the rarest, strangest and least understood of natural electrical phenomena, has recently been the subject of an unprecedented amount of discussion in scientific circles. In the hope of getting new light on this mysterious phenomenon, Dr. W. J. Humphreys, meteorological physicist of the U. S. Weather Bureau, wants reports from everybody who has observed it. He has given a list of questions on the subject to *Science Service*, with the request that observers of ball lightning send their answers to him, at the U. S. Weather Bureau, Washington, D. C.

Ball lightning is quite unlike the ordinary, almost instantaneous electrical discharge that constitutes ordinary lightning. It is a slow, long-continuing discharge, that floats through the air or runs along the ground in the shape of a ball, or sometimes the shape of a pear. The color varies from red through blue to dazzling white.

These glowing balls often enter houses, coming down the chimney or entering through a window or door or even a crack. They float or glide around, sometimes with a fluttering or crackling noise, but seldom do any harm. There are no cases on record of persons injured by them; though Dr. Humphreys reports an amusing story that came to him of a too-curious pig that nosed one with his snout and was stunned when the ball literally "blew up in his face."

Dr. Humphreys' list of questions follows:

Who saw it? Names and addresses of all witnesses should be given.
Where and when was it seen? Location, date and time of day should be as exact as possible.
Did it come at the beginning, middle or end of the storm?
Did it occur indoors or out?
If indoors, how did it get in and how did it leave?
Was there one ball, or were there more than one?
How long did it last?
What were its size, shape and color?
Was its outline sharp or fuzzy?
Did it make any noise?
Did it leave an odor?
Did it move or stand still?
If moving, did it go with the wind or against it?
Was its movement vertical, horizontal or at an angle?
How fast did it move?
Was its movement smooth or in jerks?
What were its effects?

Dr. Humphreys is especially hopeful that some one may succeed in getting a photograph of a ball lightning discharge. No really well authenticated photograph of this kind has ever been taken.

NARCOLEPSY

A SUCCESSFUL method of treating a strange disease has been reported to the American Medical Association by Dr. John B. Doyle and Dr. Luman E. Daniels, of the Mayo Clinic. Some people who suffer from this disease fall down when they laugh or get excited. Physicians call this symptom cataplexy. Suddenly, when anything arouses the patient's emotions, his muscles become weak, and he can not stand.

Another symptom seen in this disease is an irresistible desire to sleep. The afflicted person may be conducting business, he may be driving an automobile, it makes no difference what. He must sleep, and he does, whatever the consequences to himself and others may be. The name for the disease, including both the weakness and

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the sleepiness, is narcolepsy. It was recognized as a distinct condition in 1880 by Gélineau, a French physician.

In most cases of narcolepsy no cause for the condition has been found. Consequently, in the fifty years since the disease was identified and named, many treatments have been tried, none of which has had much success, except perhaps the glandular treatment of Dr. J. Ratner and of Dr. Beyermann, two German physicians.

Recently, however, Drs. Doyle and Daniels have employed ephedrine, a vegetable drug, introduced into this country less than ten years ago by a Chinese physician, Dr. K. K. Chen. Six patients whom Drs. Doyle and Daniels have treated, and two who were treated after their method by Dr. H. A. Collins, have been relieved of symptoms, most of them completely.

The discoverers of this treatment do not claim that they have a cure for this disease, for the patients must continue to take the medicine, and some possibly would have to take more of it than would be good for them, for the drug is powerful. However, several hopeless patients thus far have been restored to usefulness and happiness, and, since this treatment is not difficult for a competent physician to administer, there is nothing to prevent its wide use.

THE SURINAM TOAD

THE Surinam toad, a rare and most curious species that carries its eggs and young in pockets on its back, will be the main objective of Dr. William M. Mann, director of the U. S. National Zoological Park, when he leaves on July 22 for an expedition into British Guiana. There are a lot of other animals in South America he would like to have, Dr. Mann told *Science Service*, but his heart is especially set on getting a collection of these interesting toads for the new reptile house in the Washington zoo, the newest and finest show-place for cold-blooded animals in America.

The Surinam toad shares its peculiar form of maternal solicitude with the kangaroo, a mammal, rated much higher on the evolutionary scale. It differs from the kangaroo, however, in carrying its offspring on its back instead of in an abdominal pouch.

When the female produces her eggs, she develops deep pockets all over her back, each of just the right size to hold an egg. With the assistance of her mate, she manages to get her eggs into the pockets, where a natural sealing substance closes them in.

There they remain until they hatch, and indeed until the toadlings that emerge from them are ready to hop out and make their own way in the world. For the tadpoles of the Surinam toad, though they have gills and tails like toad tadpoles everywhere, never get a chance to swim until they are full grown. They pass through all the changes of their infancy in the mother's back-pockets, sticking their heads out through the covers, until at last their legs are grown. Then, relieving their mother of the burden of parenthood in a most literal manner, they hop along their independent jungle way.

Dr. Mann stated that though these toads are comparatively rare he has good hopes of getting at least one, and with luck may bring back half a dozen or more. He expects also to bring back many cages full of other strange animals not yet represented in the National Zoological Park collection.

BELIEF OF INDIANS IN EVOLUTION

LONG before Darwin, native Americans of the Southwest were teaching their children evolutionary ideas as a matter of course. This chapter of the ancient history of evolution in America is pointed out by Arthur Woodward, curator of history at the Los Angeles Museum.

For centuries the Zuni Indians have believed in evolution. The evidence is their creation myths, and also ancient fetishes of stone carved in the form of animals. Dr. Woodward states that "Frank Cushing, that immortal ethnologist and primal recorder of Zuni folklore, set down the Zuni tale of 'The Drying of the World' and the evolution of the Zuni from small, reptile-like forms to men who walked upright and lived as men.

"According to the Zuni, in early days men, or at least the ancestors of men, lived in the bottommost of four caves beneath the earth. Then, the Two Culture Heroes, sons of the great Sun Father, took pity on the people and by means of cane ladders permitted them to crawl from the lowest level to the next cave. Here it was a bit lighter and the people began to assume upright forms. They multiplied and became restless, seeking higher levels. In this second cave they learned more of speech and began assuming a tribal identity.

"By means of a third ladder they ascended to the third cave which was brighter, and here they began to long for the outer world. In each climbing some were left behind. In the fourth cave, those who could crawl up the cane ladder became full-fledged Zuni, having been taught the arts by the Twin Culture Heroes.

"However, the earth was then very moist, and strange creatures and man-eating animals roamed the wet surface.

"To protect men from the fierce monsters, the Culture Heroes shot magic arrows of lightning. Some of the huge beasts died where they stood and their bones turned to stone and were buried in the earth.

"The Zuni are not surprised when fossil remains are found now-a-days. They know those gigantic animals roamed the earth when it was new. They know men evolved slowly from lower forms."

The Two Culture Heroes allowed the spirits of the giant beasts to linger in the fossil remains. These powerful forces, the ancient Zuni hunters converted to their use in hunting and war. They did it by making little stone fetishes representing the animals. By feeding and propitiating the little stone figures, they could call upon the spirits for aid. The first evolutionists of America were practical as well as theoretical.

DETECTION OF FAULTS IN RAILS

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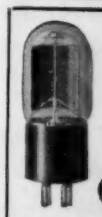

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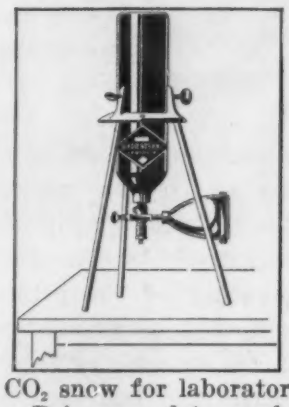

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the fact is an achievement of science that is daily saving lives. In a report to the American Institute of Electrical Engineers, H. C. Drake, engineer of Sperry Products of New York, explains how this is accomplished with the detector car, the new safety patrolman of the railroad.

The detector car, which is a small, self-propelled railway car, moves along the track at six miles per hour when examining rails. It labels the faulty rails whose smooth exterior deceives track-walkers of the hidden danger lurking in them. Operating on the principle that an electric current flowing through a rail must pass around any break in the metal, the detector car records this electrical deviation and marks the bad spot with a streak of paint.

Early in 1927, it was demonstrated in the laboratory that electricity could be used successfully to diagnose the ills, if any, of steel rails. After months of experimentation the first detector car was constructed for the American Railway Engineering Association.

Since its acceptance in 1928 by this group, detector cars have been placed in use on several railroads, and the number of bad rails located is mute evidence of the disasters averted. The human eye is always able to find cracks in rails extending to the surface, but it has remained for the detector car to see through the steel and prevent track failures, previously accounted for as an "act of God."

ITEMS

WORD of important discoveries has been received by the Bureau of American Ethnology from the largest archeological excavation which the bureau has ever attempted. The expedition, led by Dr. Frank H. H. Roberts, Jr., is working at an undisturbed prehistoric Indian site near Allentown, Arizona, and has unearthed four burials and numerous pieces of pottery, weapons and ornaments. Indians probably inhabited the village from the latter part of the first Pueblo period, which ended about 500 A. D., until some time in the third Pueblo period, which ranged from 900 to 1200 A. D. It is planned to excavate and restore the entire pueblo, placing it in as near original condition as possible. A staff of 35 workers is assisting Dr. Roberts, who considers that from three to five summers' work will be needed to restore completely the ancient site.

MOLTEN platinum gives the world its best standard of light. At the National Bureau of Standards four physicists have produced this new light standard. Using an idea suggested by Dr. G. K. Burgess, now director of the Bureau of Standards, and his associate, the late Dr. C. W. Waidner, the platinum light standard was tested experimentally by Dr. H. T. Wensel, William F. Roeser, L. E. Barbrow and F. R. Caldwell, of the bureau's staff. A flame of standard type burning fuel at a known rate has been used in the past as a standard, but its brilliance varies with changes in atmospheric conditions. Platinum, pure to one part in 30,000, is fused electrically in crucibles of thorium oxide. Comparisons with its light are made when the platinum is melting or freezing. Its temperature then is about 3,200 degrees Fahrenheit. Light produced under these circumstances is remarkably constant. Reproducibility is of first importance for a standard and the values of the platinum standard are repeatable to a tenth of one per cent. The precise value of the new light standard is 58.84 international foot candles per square centimeter.

ELECTROLYSIS, or electric separation of the elements in a chemical solution, is carried on in a new way by a process invented by Professor Alfons Klemenc, of the University of Vienna. In ordinary electrical separations, both positive and negative electrodes are immersed in the solution to be treated, and each takes out the atoms or atom-groups that are attracted to it. In Professor Klemenc's process, the negative electrode is suspended above the surface of the liquid, and separated from it by an air space. When the current is turned on, a stream of electrons is given off by the electrode into the air. The electrical phenomena that accompany this kind of electrolysis are quite different from those of ordinary electrolysis. Electrolytic reduction is carried on more easily, and electrolytic oxidation proceeds much more intensely.

A NEW source of the recently discovered metal, rhenium, which contains up to one per cent. of rhenium has been announced in Berlin by its discoverers, Dr. Walter Noddack and Dr. Ida Noddack. Previously the best ore from which the new metal could be obtained contained only one part of the metal in 660,000 of the ore. Dr. Walter Noddack has been seeking a more plentiful source of the metal for several years. Rhenium, number 75 in the order of the elements, which was discovered a few years ago, is chemically similar to the common element manganese with which it often occurs in minerals. Several thousands of tons of rhenium and rhenium compounds have been distributed among scientists throughout the world. They will study the properties of the new element on a larger scale than hitherto.

BY producing artificially the freezing and thawing conditions destructive in nature to concrete works, the investigators, Professor F. C. Lang and Professor C. A. Hughes, of the University of Minnesota, have evolved a test for gravel pebbles helpful to concrete engineers. The procedure consists essentially in immersing a sample for a few minutes in water at approximately 212 degrees and 35 degrees Fahrenheit and also in a brine solution below freezing. The samples are dried and passed over special sieves to determine the extent to which they break down. The test is then carried on with that part of the sample retained on the sieve. A definite per cent. of the sample passing through the sieve is set as the limit, and any sample showing greater disintegration is regarded as unfit for use in concrete in exposed positions. This test is important in view of the fact that a relationship has been found between the durability of these coarse materials and the concretes in which they are used.

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SCIENCE NEWS

Science Service, Washington, D. C.

FILTERABLE AND NON-FILTERABLE BACTERIA

BY DR. FRANK THONE
Science Service Staff Writer

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GIVING germs human proteins to eat is the key to the revolutionary experiments by which Professor Arthur I. Kendall, of the Northwestern University Medical School, has made invisible germs visible and caused visible ones to vanish into filterable viruses.

This work, hailed as the greatest stride that bacteriology has taken since the days of Pasteur, indicates that many, possibly all, the germs we know can change from visible to invisible and back again, according to what they feed on.

It has hitherto been impossible to cultivate the invisible germs of such diseases as influenza, smallpox and measles outside living bodies. Professor Kendall believed this to be due to the fact that all laboratory workers offered them the wrong kind of food. All traditional germ diets were made of such things as beef tea, gelatin, etc., containing the decomposition or breakdown products of proteins. But in human and animal bodies, natural prey of disease-causing germs, there are almost none of these; germs naturally feed on the pure proteins themselves.

Professor Kendall undertook to get a high-protein ration for his germs. He took pieces of small intestine, human, dog, pig or rabbit, and after treating them chemically to remove the breakdown products, made a culture fluid with what was left. Planted in this, blood from human "flu" patients caused the fluid to become cloudy. A few drops of this cloudy fluid injected into a rabbit's vein gave the animal all the typical symptoms of the "flu." Transferred from this "K medium," as Professor Kendall calls his fluid, to the old-fashioned germ foods, the germless fluid soon developed thriving colonies of tiny round germs. These appear to be the visible form of the elusive and long sought influenza germ.

Having induced one invisible germ to come out and become visible, Professor Kendall tried his hand with others. He also took germs that have hitherto been known only in their microscopically visible form, on old-fashioned culture media, and grew them in his new, high protein cultures. Every one of them turned from visible into invisible form. He filtered the invisible form germs through a porcelain filter so fine that some organic molecules can not pass through it. He took the fluid that came through and planted it on the old-fashioned germ foods again. Colonies of visible germs appeared out of the invisible. He could repeat this process as often as he liked, getting visible germs out of invisible virus filtrates, and making the visible forms change back again by planting them in his new form food.

The following germs he lists as having been "put through their paces" from visibility to invisibility and back again: infantile paralysis, streptococcus, scarlet fever streptococcus, one form of parathyroid bacillus, typhoid bacillus, the staphylococcus that causes boils, and the crooked germ that the late Dr. Hideyo Noguchi found in yellow fever patients, as well as the little round germ Professor Kendall himself found in his influenza cultures. He concludes that possibly all bacteria lead this Dr. Jekyll and Mr. Hyde existence.

A sensational by-product of this research is an insight into the nature of the bacteriophage, the mysterious filter-passing something that kills germs as germs kill us. By planting filtered "phage" on old type culture media Professor Kendall obtained good growths of the germs they destroy. Bacteriophage therefore seems to be nothing but the invisible form of the germ it seems to delight in wiping out. Professor Kendall could produce phage from germs by planting the germs in his new medium.

The behavior of germs in changing from visible to invisible is peculiar. They begin to lose sharpness of outline, growing fuzzy and dim under the microscope. At last nothing but tiny granules remain, which will pass through the fine filters, and grow back (or perhaps reassemble themselves) into visible germs again. Other granules, too large to pass through the filter, appear none too anxious to resume full-fledged germ form, but under proper encouragement in the new medium will do so.

This new knowledge of the changeability of germs can be found in patients in the early state of the disease, but not in the later, though the patients are sicker than ever. But certain puzzling granules have been found in the spinal fluid of such patients, and it now appears quite possible that these may be the half-transformed germs themselves, on the road to invisibility.

Professor Kendall calls attention to the fact that the majority of known filterable virus diseases, like common cold, influenza, measles, etc., enter the body through the lungs and not through the digestive tract. The digestive tract is always full of decomposition products of proteins which tend to keep germs in the visible, non-filterable phase.

For further experiments he has a new refinement of his medium, made of highly purified, crystalline proteins. This will replace the one he used in these experiments.

NAGATA'S COMET

A COMET, with a tail eight times as long as the moon's diameter, is now on exhibition in the early evening skies.

A small telescope is needed at the present time to see this visitor to the solar system since it is not bright enough to be seen with the unaided eyes. The tail is difficult to see in a small telescope, but can be found on astronomical photographs.

It is located in the constellation of Leonis, the Lion, a little east of the bright star Regulus, which is in the handle of the Sickle pattern of stars in that group of stars. This constellation is visible near the western horizon just after sunset. As Leo and its comet go to bed behind the horizon shortly after the sun, it is necessary to look for the comet just after sundown.

The comet, probably new to astronomy, was discovered by Masani Nagata, of Brawley, California, on July 15, at 8:30 P. M. He reported his finding to the Mount Wilson Observatory where Glenn Moore, with one of the 12-inch telescopes, confirmed its discovery and made photographs. Other observations were made and then astronomers throughout the world were sent telegraphic notifications through the Harvard College Observatory, the distributing center of astronomical data.

The position of Nagata's comet, as determined at Mount Wilson on the evening of July 19, is right ascension ten hours forty-nine minutes and twenty-two and three tenths seconds and declination north nine degrees fifty-eight minutes twelve seconds. It is between seventh and eighth magnitude and its tail is reported as four degrees long.

The comet is moving north and east so that it may stay in view for some time. Whether it will become visible to the naked eye can not be told until an orbit is computed. Astronomers are now at work on this laborious mathematical task.

Nagata's comet gives more promise of being seen easily by the public than any comet of recent months. The solar system has had very few visitors from outer space in the past few years and it has been years since a really striking comet appeared in the skies. There is no hope that Nagata's comet will become visible to the unaided eye. Orbit computations made at the University of California's Students' Observatory under the direction of Professor R. T. Crawford show that the comet was nearest the sun on June 15. It was then one hundred million miles from the sun. It is now one hundred and sixty-seven million miles from the earth. It is receding from both the earth and the sun.

The orbit shows that the comet will be four degrees south of the star Beta Leonis on August 3 and that it is moving eastward two degrees a day. Its orbit is inclined to the ecliptic 41 degrees.

[EDITOR'S NOTE: This is the exclusive story of how a Japanese melon ranch worker discovered the new comet. He tells it in his own words.]

STATEMENT BY MASANI NAGATA

(Copyright 1931 by Science Service)

I am purely an amateur astronomer. On July 15, about 8:30 P. M. Pacific Standard Time, I was observing the planet Neptune with my three-inch telescope which has a thirty diameter eyepiece of eighty millimeter and an altazimuth mounting. Near one of the stars, in the constellation of Leo, I found what seemed to be a nebulous hazy star. As I am very familiar with that area of the heavens I was therefore very puzzled and doubtful about what I had seen. Soon the hazy unfamiliar star faded away under the horizon.

The next evening at about 8 P. M., observing the same point, I found the same "star" moved about one degree to the northeast. It seemed to be a comet. As I could not believe that a comet of this brilliance, magnitude seven, could have escaped the eyes of thousands of comet-seekers with much more improved and more efficient instruments than mine, I inquired at Mount Wilson Observatory if such a comet were known. They replied in the negative. Then I pointed out to them the position and they answered me that two photographs they had taken showed the comet.

As I am only an amateur astronomer, and I have had no special study or courses in astronomy in school. Perhaps I inherited my interest in the stars from my father. I am head foreman for one of Sears Brothers, Inc., ranches near here, which grow vegetables and melons. If this discovery does anything for the good of astronomy, nothing will please me more.

EARTHQUAKES IN THE MISSISSIPPI VALLEY, CHILE AND SIBERIA

EARTHQUAKES in the Mississippi Valley of this country, Siberia and Chile were recorded on American Seismographs on Saturday (July 18) and their location determined through the earthquake reporting service of *Science Service* and cooperating agencies.

The Mississippi Valley earthquake was not severe but it was centered in the region near New Madrid, Mo., where in 1811 and 1812 the famous series of New Madrid violent earthquakes occurred. Saturday's shock (July 18) which came at 8:45.3 A. M. Eastern Standard Time was recorded on the seismograph at St. Louis University, St. Louis, Mo., and reported to *Science Service* through the Jesuit Seismological Association.

The region of northern Chile near the town of Iquique on the coast was probably shaken and perhaps damaged by the earthquake at just 27.1 minutes after midnight early Saturday morning (July 18) which was recorded by Fordham University at New York City, St. Louis University at St. Louis and the Seismological Laboratory at Pasadena, Calif. The epicenter of the earthquake was determined by both the U. S. Coast and Geodetic Survey and the Jesuit Seismological Association experts to be at latitude 21 degrees south and longitude 71 degrees west, in the Pacific Ocean just off the Chilean coast.

The Siberian earthquake was located in the region of the Bay of Kronotski on the east coast of the Kamchatka Peninsula and its time was 6:23.9 A. M. Eastern Standard Time on Saturday (July 18). Fordham University, St. Louis University, Pasadena Seismological Laboratory and the U. S. Coast and Geodetic Survey station at Tucson recorded it and the latitude and longitude as determined by the U. S. Coast and Geodetic Survey was 53 degrees north and 162 degrees east. Because of the sparsely inhabited region this quake probably did little damage.

With the earthquake that centered off the west coast

of Mexico on Friday morning and the local, probably volcanic earthquake in Ecuador the same day, the earth has been very restless the past few days.

THE TIDES OFF CAPE COD

THE strange whirlpool reported off Cape Cod was probably not a whirlpool at all but merely the every-day movement of currents which rip and surge over the shoal areas of George's Bank. This is the opinion voiced to *Science Service* by Commander G. T. Rude, chief of division of hydrography and topography of the U. S. Coast and Geodetic Survey. Commander Rude has just returned from a two-weeks' inspection tour of the four Survey vessels now engaged in the first complete charting of George's Bank.

"Currents passing from ocean depths over shallow areas must necessarily speed up considerably," said Commander Rude in explaining the occurrence, "and the fact that the water sometimes rises up above the surface in 'tide-rips' may account for the idea of 'whirlpools.'"

Commander Rude expressed the belief that such statements as Captain W. E. Parker, of the Coast Survey ship, *Hydrographer,* who is said to have described the whirlpool, made to the newspapers had been misconstrued. Commander Rude was at George's Bank when Captain Parker charted some of the shoal area at its rough spots and was aboard the ship *Hydrographer* for several days.

Commander Rude also said that observation of the "whirlpool" was made at the time of the spring tides when the new moon gives the ocean currents forty per cent. more strength than when the moon is at the quarter. "Thus," he pointed out, "a current of three or four knots moving where the depth is not more than thirty or forty feet is powerful enough to be felt on the side of a Survey vessel but would not, of course, hinder its head-on progress or jeopardize its safety."

The Coast Survey vessels left the base at Boston, July 21, after a short trip to port and will continue the charting until the latter part of September when weather conditions make the work impracticable. The work of charting George's Bank began last summer and will be carried on during the summer of 1932, when it is expected to be finished. George's Bank is a tongue-shaped area of 15,000 square miles lying about 200 miles east of Cape Cod.

ITEMS

HIGHLY purified iron, possessing many of the qualities of copper, is prepared in Germany by a new process described recently by Dr. Ing. L. Schlecht. Carbon monoxide of a high degree of purity is passed over hot iron, previously purified by ordinary methods. The two unite to form a liquid of relatively low boiling point, iron carbonyl. Heating this drives off the carbon and oxygen, leaving iron with hardly a trace of impurities, in an exceedingly finely powdered form. The individual spherical particles are only 20 millionths of an inch in diameter. Heating this powder to a temperature of 1,200 degrees Centigrade changes it into solid iron that resembles copper in its softness, resistance to corrosion and other properties.

ATOMS, even the heavy atoms of lead, are wanderers. Professor J. G. von Hevesy, of the University of Freiburg in Breisgau, has been investigating their properties. Lead atoms are constantly in motion, even in solid metal, he believes. In an alloy of lead and gold, at a temperature half again as high as that of boiling water, the atoms wander through a space of a hundredth of a cubic inch in a day. When there is nothing but lead in the lump, however, moving about is not nearly so easy; in pure lead an atom can migrate in one day through a space of only two ten-billionths of a cubic inch.

MAGNETISM will detect differences in hardness of otherwise similar bars of steel, it was revealed in a report made by Haakon Styri, of Philadelphia, to the American Society for Testing Materials meeting in Chicago on June 24. Steel bars that test magnetically the same before heat treatment will test magnetically the same afterwards, Mr. Styri said, provided no differences in hardness or impact strength are brought about during the heating and quenching processes. Mr. Styri's method of testing is to place the steel bars in a magnetic field and note whether the steel would make a good core for an electromagnet. Former methods of testing uniformity in steel hardness, according to the report, have required mechanical means which involve partial destruction of the steel, whereas the testing of the steel's magnetic properties does not have this disadvantage.

OYSTERS open up when the water over their beds grows warmer, and they shut up when it gets cooler, has been found by Dr. A. E. Hopkins, of the U. S. Bureau of Fisheries. It was previously thought that oysters opened by day and closed at night because of light changes, but Mr. Nelson's experiments indicate that it is the daily changes in water temperature rather than the daily light changes that affect the behavior of the shellfish. The experiments were performed on the Pacific coast oyster, but there are indications that the conclusions from the study hold good for the Eastern oyster as well. The opening and shutting of oysters is of very great practical importance, because oysters can feed only when their shells are open.

DIGGING in a cave at Cedar Grove, Arkansas, an expedition from the Bureau of American Ethnology has discovered the burials of twelve individuals and hundreds of the tools, weapons and beads that once belonged to them. Ozark life and culture is comparatively unexplored and unknown, it was stated at the bureau. Two previous expeditions had made some progress, but much is yet to be discovered. Dr. W. M. Walker, in charge of the cave expedition, states that he has uncovered the burials of four adults, one adolescent and seven children or infants. Among the relics collected are 233 flint objects in perfect or nearly perfect condition, fifty bone implements and numerous shell spoons and beads.

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SCIENCE NEWS

Science Service, Washington, D. C.

INFANTILE PARALYSIS

PLANS to prevent a wide-spread epidemic of infantile paralysis this summer were formulated at a conference of health officers held in New York on the invitation of Dr. Shirley S. Wynne, commissioner of health for New York City, and Dr. Thomas Parran, state health commissioner.

A large outbreak of cases has been reported from New York City, particularly from the borough of Brooklyn, which is where the terrific epidemic of 1916 started. For the week ending July 25 there were 195 cases in New York City, with only 89 cases in 27 states reporting to the U. S. Public Health Service. For the corresponding period last year only 15 cases were reported from New York City with 77 cases from the same 27 states. For the corresponding week in 1916, the year of the biggest epidemic of the disease ever known, 899 cases were reported from New York City, with the majority of cases then as now reported from Brooklyn.

This similarity in starting point of the outbreak has caused considerable concern, although the conference of health officers stated that there was no cause for undue alarm. They recommended that parents watch their children carefully and be on the lookout for early signs of the disease.

The conference ruled that state health officers should advise directors of all summer camps to discourage visiting of the children by parents or friends from outside the camp. State health officers are also to advise superintendents of all institutions housing children, such as orphan asylums, boarding homes and special schools, to forbid any outside visitors to the children. The experience in such institutions during the 1916 campaign was that in the institutions forbidding outside visitors outbreaks of the disease were averted. The conference also urged complete reporting of all cases as a measure which would help to keep the outbreak somewhat under control. When it is necessary to move an infantile paralysis patient from one place to another, such as from the country to the city to get hospital treatment, the local health officer must notify the state health officer of the move, so that the latter may take steps to guard against spread of the infection in the new locality.

Participating in the conference were representatives of the health departments of the New England states, Pennsylvania, New Jersey, Maryland and Ohio, and two medical officers from the U. S. Public Health Service.

THE ECLIPSE OF 1932

OBSERVATIONS to determine the exact path of the total eclipse of the sun, on August 31, 1932, by photographing the northern and southern edges of the moon's shadow as it sweeps across the earth will be made by a group of amateur astronomers at Springfield, Vermont.

This was announced at the sixth annual meeting of Amateur Telescope Makers, by Russell W. Porter, of the California Institute of Technology. Mr. Porter, whose home is in Springfield, some years ago guided a group of factory workers in making their own reflecting telescopes, and since then the movement has spread to all parts of the country. Though he is now spending the winters in California, working on the preparation for a 200-inch telescope, he returns to Springfield every summer.

The eclipse next year will be visible a few miles east of Springfield. With the cooperation of Dr. John A. Anderson, of the Mount Wilson Observatory, Mr. Porter has outlined a plan for observations that can be made without expensive equipment. The photographs of the edge of the moon's shadow will be made by observers stationed on hills, about five or six miles inside the path. It is expected that the two sets of photographs, if successful, will permit a very close determination of the extent of the path, and hence of the moon's position in space.

Other photographic observations will be attempted of the elusive shadow bands that appear before and after the moon totally eclipses the sun. For this, a large sheet of ground glass, or tracing cloth will be placed between the camera and the sun.

As the shadow bands appear on the screen, an effort will be made to photograph them from behind. It is also expected that motion pictures will be made of the corona, the outer layers of the sun, visible only during a total eclipse.

This year's gathering of the telescope makers included more than a hundred amateurs from all parts of the country. Present were engineers, bankers, lawyers, schoolboys and housewives, who have had the thrill of seeing such heavenly sights as the rings of Saturn or the mountains of the moon, through telescopes made entirely by their own hands. They gathered at Stellafane, the astronomical clubhouse established on a near-by hill by the original Springfield group. Set up around the building were telescopes of all sizes, some brought by visitors, others made by the local group.

Largest and most unique is the turret reflecting telescope, invented by Mr. Porter, and recently placed in adjustment. In this instrument the large concave mirror, that brings the light rays to a focus, is placed at the end of a framework projecting from a turret. A flat mirror close to the turret reflects the light from a distant star to the curved one, which sends it back, through a hole in the flat one and into the turret, where the view is seen by the observer. By moving the turret and the flat mirror from within, any part of the sky can be reached. This instrument has the advantage of protecting the astronomer from cold weather in winter, or from insects in summer.

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carelessness in the kitchen than to the use of unfit ingredients. Thorough heating of all food products; protection against contamination by dust, flies or other insects, rats and mice, and against contamination by human carriers of disease-producing bacteria; cleanliness and careful refrigeration are among the recommended precautions. Botulism, an increasingly serious source of food poisoning, is caused most frequently by home-canned goods which have not been completely sterilized in the canning process and in which the *Clostridium botulinum* organism develops its powerful poison.

Home-canned string beans and home-canned corn have frequently been sources of botulism. Almost nine tenths of the poisonings observed in the United States are caused by vegetables of various sorts preserved in brine; animal products are involved in less than one fifth. Canned goods containing a large amount of liquid appear more liable to the contamination than to relatively dry products.

While it is possible that ingredients such as eggs, milk or meat may be the vehicles of infection carrying poisoning organisms into the prepared mass, their development there is possible only because of failure to destroy them by adequate heating or to prevent their development by sufficient preparation, according to a bulletin on food poisoning. Foods such as meat pies, scalloped fish or oysters, hash, some salads, puddings, custards and cream pie fillings are frequently the cause of illness due to the fact that in their process of preparation insufficient heating is used to destroy the bacteria or their toxins and such prepared foods offer extremely favorable conditions for the development of bacteria if inadequately heated and improperly stored after preparation.

In the case of botulism, the food itself is made poisonous by the contaminating organism. Sometimes there is present an infection which makes a poison in the body of the host after the food is eaten. Trichinosis is often regarded as a form of poisoning caused by underdone pork. In reality, it is a disease caused by a parasite contained in infected pork. If the meat is sufficiently cooked to kill the parasite, the same pork can be eaten without dangerous results.

"Ptomaine poisoning" was at one time a popular explanation for the majority of cases of food poisoning. It was thought that protein foods degenerated into a toxic substance. This theory is now dismissed as false, and infection is blamed for the majority of food poisoning. Occasionally harmful chemical adulterants in food cause poisoning. Cases of gin paralysis have been traced to a poison present in adulterated forms of Jamaica ginger. Some cases of food poisoning have been traced to toxic substances contained in silver polish and consumed with the food.

Several epidemics of food poisoning on the Pacific Coast have been traced to a variety of mussel which becomes poisonous during the summer months. At first it was thought that the sickness incurred from eating the sea food might be caused by bacteria or by some pollution, but investigation has revealed that it is due to a poison originating in the mussel itself, the actual cause of which is unknown.

THE CONTROL OF GRASSHOPPERS

FACED with the prospect of a grasshopper inundation, Iowa farmers are preparing to employ a weapon the insect does not possess—strategy. The futility of completely warding off the attack of the hoppers, whose battle lines are advancing steadily eastward, has been realized. In consequence plans are being laid to deal a death blow to the grasshoppers which will carry on the war next spring after the lull of winter months.

Insect eggs by the thousands are being laid in the warm, firm soil now, and it is the young which hatch out in May and June that will attack the farmers' crops afresh. Iowa entomologists hope they will not live to do damage. Reports received at the U. S. Bureau of Entomology disclose that poison bran mash, the grasshopper nemesis, will be distributed in the spring of 1932 to destroy the pest before they develop and assemble in swarms which devour all cultivated crops.

Lack of funds occasioned by the drought prevented the more western farmers of South Dakota from declaring war this year on the grasshoppers as they first appeared. Other states were warned of the impending plague, but could do little toward stemming it.

The second strategic move which Iowa men will take is to plow their fields—many of them already stripped—in order to crush the egg deposited by the female grasshopper in a membranous pod an inch or so below the surface of the soil. If the rains come in the spring and the temperature lowers, man will find an ally in the weather as the hoppers can not survive in the present multitudes.

Iowa entomologists believe that unless such precautions are taken the situation next year will be unimproved and farmers will find themselves confronted with another despairing task.

DECLINE OF MAYAN EMPIRE

BECAUSE the face of the land in which they lived began to change insidiously, fatally, the Mayas of prehistoric America temporarily lost their grip on civilization, and their first Empire fell. This, at least, is the view advanced by a geologist who has returned from the region where America's greatest prehistoric civilization once flourished and then mysteriously succumbed.

The geologist, Dr. C. Wythe Cooke, of the U. S. Geological Survey, was sent by the Carnegie Institution of Washington to study the region within traveling range of the institution's camp at Uaxactun, Guatemala. Reporting his observations in the *Journal* of the Washington Academy of Sciences, Dr. Cooke describes the hill and lowland country as it is, and as it doubtless appeared in the days when the Mayas had their beautiful cities and their farms there.

The hills to-day are forested with big trees and a little underbrush. The lowlands are flat plains covered with a tangled mass of gnarled and twisted trees, festooned with vines. In the rainy season these low

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This monograph collects, correlates, and interprets a mass of material which has recently developed in a new field of very general interest. The modern mathematical theory of the dielectric constant is outlined and its use in calculating the electric moments of molecules is shown. Phenomena related to dielectric constant and moment are described, among the subjects treated being molecular association and anomalous dispersion for radio frequencies, which is of special importance in problems of insulation. The main body of the book is devoted to the general relation of the electric or dipole moment to the structure of the molecule and to the particular relation of moment to structure in many molecules, radicals, and classes of compounds. Such problems as the structure of the benzene ring, electronic theories of valence, and the relation of refraction to structure are treated. The book makes available to the physicist, the chemist, and the electrical engineer the results of many recent investigations, showing the success of a new method of attack upon the molecule and describing methods for the further prosecution of the attack.

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plains are flooded. At one time evidently the plains were lakes all the year round, affording plenty of water for the region and good transportation. Both water supplies and transportation are highly inadequate to-day.

Dr. Cooke suggests that quite possibly the transition from lake to lowland took place during the time of the Mayan Empire. If so, this would explain many facts about Mayan economics now hard to understand.

"One may imagine the Peten District of Guatemala when first occupied by the Mayas to have had a thick fertile black soil," he states. "During the many centuries of the Mayan occupation more and more of the soil was washed away until the bare limestone was exposed. Then the land was abandoned and reverted to the jungle."

The erosion of the soil would have been enormously accelerated when the Mayas lived there, for the Mayas cut down the forest to grow quantities of corn for their large population.

If the geography of the region in Mayan days had been as it is now, all the provisions and merchandise would have had to be transported on the backs of men. Human burden bearers would have had a hard time of it traveling from one city to another over the low plains with their wild tangle of growth. But if we think of the lakes as they once were, it is easy to see that travel about the land in boats would have been easy, with only short overland distances to be covered between the large lakes.

The calamitous change of the lakes into plains may have brought disease to the Mayas as well as inconveniences. So long as the lakes were deep near shore, fishes would have eaten up the mosquitoes, but when the water became swamps and marshes, the mosquitoes must have risen up to plague the people, and malaria may have hastened the decline of the fine cities of the Old Mayan Empire. The once-populous region is to-day almost totally uninhabited.

ITEMS

PROBABLY for the first time, the two separate stars that constitute the body called sigma Scorpii have been observed separately. Professor Bernhard H. Dawson, of the observatory of the Argentine National University, saw them as the star emerged from occultation behind the moon. The interval between them was such that he figures their distance to be about one tenth of a second or arc, or about one eighteen thousandth the diameter of the moon in the sky. No existing telescope is powerful enough to separate such close bodies when observed in the usual way. Sigma Scorpii has been known in the past to be a double, or binary, from a study of its light through a spectroscope. As its two components revolve around each other, one approaches the earth as the other recedes, then their rôles are reversed. This causes the dark lines that appear in their spectra to separate and then come together. Many such bodies, known as spectroscopic binaries, are recorded in star catalogues, but Professor Dawson's observation is believed to be the first actually made of one component separately from the other.

THE danger to health and life of methanol, cheap synthetic wood alcohol which is being widely used as an automobile radiator anti-freeze and in certain industries, is not limited to its use as a beverage, Dr. Carey P. McCord, of the Industrial Health Conservancy Laboratories at Cincinnati, has reported to the American Chemical Society. The deaths last winter of 208 persons who drank methanol has overshadowed its other dangers, Dr. McCord pointed out, and urged that unusual protective measures for the safety of the public and of industrial workers are needed. Methanol is now finding wide use in such industries as dry-cleaning, hat-making, metal-working, painting and cabinet-making. Dr. McCord found in investigations with animals that methanol is just as dangerous when absorbed through the skin or when its vapor is inhaled as when the liquid is drunk. Authorities are not agreed, however, on the question of whether methanol is dangerous through skin absorption and inhalation.

THE unusual case of a man who lived for fifteen years with two sewing needles in his liver has been reported to the American Medical Association by Dr. George de Tarnowsky, of the University of Illinois College of Medicine. The patient, a man 52 years old, came to the hospital supposedly suffering from stomach ulcer of fifteen years' duration. He showed anxiety, and was reluctant to tell much of his past history, but confessed to his pastor soon after entering the hospital that he had tried to commit suicide fifteen years before by pushing two sewing needles into his abdomen. X-ray examination showed their position, and they were removed by operation. One needle had broken in half. One was found in the liver and the other in the ligament which helps to attach the liver to the diaphragm. The patient made an uneventful recovery and was completely relieved of the former symptoms.

DOCTORS examining emigrants from here to Canada are instructed to pay special attention to psychological factors, according to the *Lancet*, British medical publication. The medical examination is required of all classes of emigrants desiring to live permanently in Canada. It is hoped that the examination will detect not only the obvious physical or mental defects in prospective emigrants, but also those persons who have defective judgment, unstable nervous systems, or who are emotionally oversensitive. Release from restraining influences of the home environment is often too much for persons lacking in self-control or moral responsibility, the *Lancet* points out. The psychological stress of a complete change of environment is considerable. Comparative isolation in outlying districts; changes in money standard, food, cooking and dwellings; complete change in local interests and details of social life and activities; difference in customs and routine methods of doing business and work generally all tend to produce homesickness of such severity as to be really disabling.

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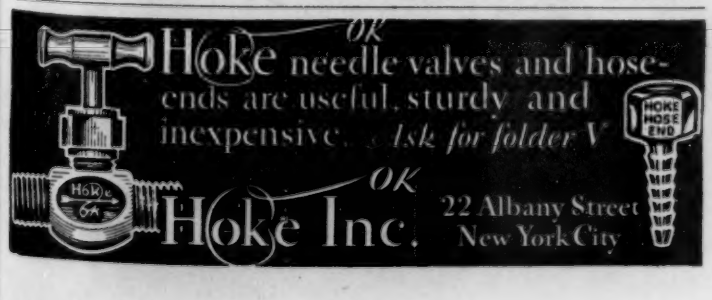

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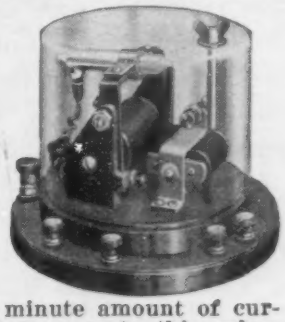

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SCIENCE NEWS

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A NEW BLOOD TEST

CASES of doubtful parentage of children, such as agitate the courts from time to time, may possibly be decided with more certainty in the future, if a new blood test originated by two British investigators is developed to a point that now appears possible. The first experiments leading to the new technique were performed on cattle in Egypt by Dr. C. Todd and Dr. R. G. White, and further researches were conducted on fowls in England by Dr. Todd working alone.

The test depends on the reactions of blood to foreign bodies that get into it. Blood invaded by germs, blood corpuscles of another animal, or anything else that does not belong there, generates substances to fight against the invaders. These substances are known by the general name of "antibodies." The familiar antitoxins used against various diseases belong to the antibody classification.

Foreign corpuscles that find their way into the blood stream are attacked by two different types of antibody. One of them tends to dissolve the outsiders and is called a "hemolysin," or simply "lysin." The other makes them stick together in clumps, and is called an "agglutinin." Both lysin and agglutinin reactions were used in these researches, the former in the cattle work, the latter in the work on fowls.

Following hints contained in earlier researches, Dr. Todd and Dr. White first found that antibody reactions are not the same if corpuscles from different animals are used with the same blood sample, and that conversely blood corpuscles from the same lot will dissolve less readily in one individual's blood serum than they do in another's.

The key to their discovery came when they found it was possible to "exhaust" the antibody in a given preparation of sensitized serum. By adding considerable quantities of corpuscles from one individual to such a serum sample, a point is finally reached where that serum will no longer have any effect on corpuscles from that particular source, though it will continue to destroy any other corpuscles that are added to it.

To do away with the large individual differences in reactions of separate lots of serum, "polyvalent" sera, obtained by mixing together sensitized sera from a large number of different animals, was prepared. This ironed out the individual variations, and made the mixture about equally effective against all corpuscles of the species used in its production. When this serum was "exhausted" with corpuscles from a single individual, it became highly selective, sparing those corpuscles only and destroying all others, except that in some instances it was not so destructive to blood corpuscles from animals nearly related to the test specimen.

The possibility of testing blood relationship was thought of by Dr. Todd when he was working on his fowls in England. He bred three different families of chickens, and tested blood obtained from the chicks against the corpuscles of their parents. In all cases but one, there was a strong "family reaction," the blood corpuscles of both parent fowls combined reacting toward the chick serum as the chick's own corpuscles would. Taken separately, either paternal or maternal corpuscles might fail to react; though where one failed the other always reacted. Thus a negative test would not necessarily indicate that parenthood could be denied, but a positive test would definitely mean that the individual so reacting, and none other, could be the parent.

So sure was Dr. Todd of the validity of his test that in the one case that failed, he tried the "errant" chick's blood against the parental corpuscles in his two other fowl families. It fitted one of these, and he concluded that there had been a mistake in marking the eggs before hatching, causing a mix-up in his records, and that the chick really belonged where its blood indicated and not where the note-book put it.

ST. VITUS' DANCE IN CHILDREN

FEVERS, used these days to burn out certain ailments of the human system, now seem to check St. Vitus' dance in children.

Twenty-four children have been treated by fevers artificially produced by manufactured serum. Dr. Lucy Porter Sutton, working in Bellevue Hospital in New York City, reported these cases to the American Medical Association. The average time of the children in the hospital was nine days. Sixty-three cases used for comparison treated by other means stayed on an average of forty-seven days in other hospitals. The usual treatment is rest and quiet. Dr. Sutton used typhoid-paratyphoid serum because it gave fevers for successive days which promptly stopped the symptoms. The discovery was an accident. Dr. Sutton was treating an extreme case of St. Vitus' dance in a boy. He was given a drug as a sedative. It had no beneficial effect and only aggravated the disease. But through a misunderstanding the drug was not stopped until the thirteenth day when a rash and a fever developed. This was traced to poisoning from the drug. It was noted, however, that the disease abruptly improved, after an irregular fever that rose as high as 106.4 degrees. A consideration of various factors convinced Dr. Sutton that it was the fever that cured.

She then tried small doses of typhoid serum because it was a safe and simple way of giving fever, and found it effective in cases tried. Later, typhoid-paratyphoid serum was chosen because it was a still simpler, safer and cheaper way of giving fever. The twenty-four experimental cases were treated in this way more rapidly and more satisfactorily than any other cases of St. Vitus' dance which had heretofore been treated in

Bellevue Hospital. But Dr. Sutton still considers the treatment in an experimental stage.

Fever treatment of disease is already well-known in the case of extreme syphilis or paresis.

HIGH WINDS AND THE PROBLEM OF FIRE CONTROL

UNPRECEDENTED high winds which parch the land and sweep flames along tree tops have made the fire control problem in northwest forests exceedingly acute. Western Montana and Northern Idaho are the focus of raging conflagrations which have cost homes and lives of stock, and have ruined hundreds of productive acres.

Eastern Montana is drier now than ever before, while the whole state, as well as Washington, Idaho and Oregon, suffer from the cumulative effect of a drought increasing steadily for the last ten or eleven years. Lack of spring rains, according to Roy Headley, of the U. S. Forest Service, resulted in forest fires breaking out in these states in April of this year. Never before at such an early date, he said, have such destructive blazes been encountered.

During the latter part of June, some precipitation occurred in the northwest region, but was quickly nullified by the intense wind and heat which dried up the moisture. Wyoming, Colorado, Utah and South Dakota have been in the grip of the drought until recently when some rainfall occurred. In Arizona and New Mexico summer rains have made conditions normal. Destruction by fire has been reported to forests throughout the west; since July, fires have not been serious along the Atlantic coast. In general, the drought conditions and resulting fires are believed to be considerably worse this year than last.

Figures from the U. S. Forest Service show that already in the national forests alone, at least 251,000 acres have been severely burned, while the total for 1930 was only 205,000 acres, and the season of fires is far from being over.

Because of the unusually high winds, fire fighters have frequently found it impossible to cope with the sweeping flames. Where the fires advance along the ground, ditches may be dug and backfires started to clean the land and cause the fire to die out. But when nature's bellows fan the flames into the tops of trees, there is no stopping the fire and fighters must flee for their lives.

Lightning is charged with causing almost two thirds of the fires in the Pacific northwest. Lookouts posted at strategic points report them as soon as sighted and the rush begins to surround the burning area and prevent it from enlarging. Sometimes it is possible to look at a storm and tell whether it is the kind likely to cause a fire. Besides the natural agencies, Mr. Headley stated, the careless smoker is the worst. Despite the precautions taken, untold damage results annually from the habits of man himself.

THE NEXT U. S. NAVY AIRSHIP

ALTHOUGH the next U. S. Navy airship to be built is ordered as a duplicate of the new *Akron*, the future craft will in all probability be a far better ship. Final work is now being done on the *Akron*, which is nearly twice as large as the *Graf Zeppelin*, preparatory to trial flights planned for the next few weeks. The next airship will be superior not because of any radical changes in design engineers might make with the approval of the Navy, but rather as the result of refinement of individual features and details indicated by experience with the *Akron*. It will be a matter of following the immediate precepts of experience, as teacher.

This kind of development, in the opinion of Dr. Karl Arnstein, designer of the *Akron* and formerly in charge of the design and building of seventy military and commercial airships for Germany, is what the aviation industry needs just now in order to make greatest progress.

Dr. Arnstein states that the aviation industry is well past the pioneering stage in both the lighter and heavier-than-air branches, and that the possibilities of flight have been conclusively demonstrated and now we have available a variety of ships suitable for all types of commercial operation. From now on, what we need is less invention and more application of the basic principles we have already learned. It is surprising what great progress can be made when invention is neglected and application emphasized.

Dr. Arnstein referred to his work in Germany during the war when there was not time for research and Zeppelins had to be built as fast as possible according to previously worked-out designs. By careful attention to the details and without making any radical changes, he said, he and his engineers were able to build the *LZ–62* so that it would carry a load of ten tons more than previous ships of the same size and general design which lacked detail refinements.

Just what changes are to be suggested to the Navy will not be definitely known until the *Akron* takes to the air and her behavior is studied. Then engineers will see where improvements can be made. For example, it is doubtless true that in their desire to make the *Akron* a safe airship, the engineers often used unnecessarily large factors of safety. These can be trimmed down to give the ship greater carrying capacity.

Dr. Arnstein said that he is sure the new outriggers which project the propellers beyond the ship's surface could be built with less weight and resistance, after engineers have had an opportunity to study them sufficiently. Likewise, he believes the radiators, which belt the huge framework at each engine and condense water from exhaust gases to make up for the loss of weight of fuel, can be designed more efficiently.

THE FREQUENCY OF WORDS USED OVER THE TELEPHONE

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SCHOOL AND SOCIETY

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Thus might be summarized findings of a study of the words and sounds of telephone conversation reported in the Bell System Technical Journal. Obviously this study, conducted by Norman R. French, Charles W. Carter, Jr., and Walter Koenig, Jr., points an accusing finger at the diminutive vocabulary of the average American, even when 500 different people pool their resources of speech. But it does more than that.

This is believed to be the first study of the frequency of speech sounds in oral English, the scientists believe. Written matter has been analyzed before and the results of these past researches supply interesting material for comparison with the study of oral speech. There is also another reason for the research. By finding what sounds are repeated most frequently, telephone engineers may work toward improving their transmission.

Observations were made on typical toll conversations in New York City. During one week the person listening-in recorded verbs only, the next week nothing but nouns and the third week adjectives and adverbs only. Data was taken on 500 conversations each week.

Thus the information gathered from many conversations was equivalent to complete data on 500 "average" calls. The thousand people taking part in these average calls used 80,000 words, only 3 per cent. of which were different words.

Apparently, over the telephone people talk about themselves more than about any other subject, for more than 7,500 of the 80,000 words were the pronouns "I" and "you." In fact, 121 different words which constitute the minor parts of speech form more than half, 45,000, of the total occurrences.

As might be expected, telephone conversation is made up of more smaller words than the written English previously studied. In conversation, the 155 most frequently used words make up 80 per cent. of the total occurrences, while to reach the same percentage in written English, 640 words must be included.

Strangely, more words of Latin origin are used in conversation than in writing. Of the 100 most frequently used words of conversation, 11 are of Latin origin as compared with only two from the first 100 written English. Twelve active verbs such as "get," "see" and "know" occur among the 50 most used words of conversation, yet are entirely absent from the first 50 words of written English.

More than four fifths of the conversation words were naturally monosyllables, largely a result of the frequent repetition of the minor parts of speech, of which 95 per cent. are monosyllables.

Of the telephone calls observed, 86.5 per cent. were between two men and only 10.4 per cent. between two women. As the observations were made at random, apparently men make more toll calls in New York than women. It would be interesting to repeat the study with observations on more women's calls than on calls of men.

ITEMS

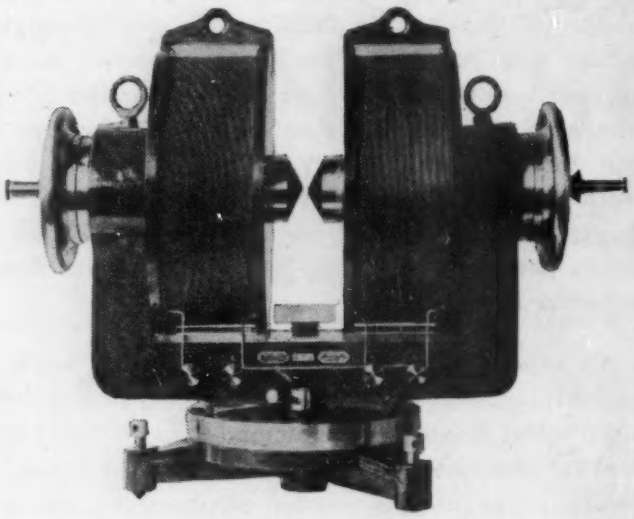
STATISTICIANS of the Metropolitan Life Insurance Company report that in spite of influenza and unemployment which always boost it, the tuberculosis death rate is six per cent. less for the first half of 1931 than the record low point reached last year. Diphtheria dropped 35 per cent. in fatality. Whooping cough was a little less fatal, but deaths from scarlet fever and measles increased. The year 1931 so far has had more influenza and pneumonia, and the rise in the cancer death rate has been particularly disturbing. The diabetes death rate is up, also heart disease and cerebral hemorrhage. Violent deaths from suicide, homicide and automobile accidents increased, but violent deaths from all accidents alone are less.

AN obstinate case of eczema was traced by a Hungarian physician, Dr. Stephen Rothman, to handling too much metal money. A communication to the American Medical Association tells how he found the cause of the disease. The patient counted silver, nickel and copper coins for the Budapest street car company all day, and had eczema on his hands, underarms, shoulders and neck. Tests with clean and sterile coins on the skin brought about swellings and inflammations and the salts of these metals proved still more irritating. But another healthy person was not at all affected by these.

WIDE introduction of four-wheel brakes and tremendous increase in commercial transportation by automobile has rendered obsolete the national safety code for braking systems. Under a new code, being prepared under the auspices of the American Standards Association, all types of brake and brake-testing systems for both commercial and passenger vehicles will be covered; at present only two-wheel brakes on passenger cars are dealt with. More than thirty national organizations, including automobile manufacturers, associations and technical bodies, will cooperate in drawing up the new code.

A NEW type of stone-bladed tools that were used by Stone Age men and women thousands of years ago has been discovered in South Africa and reported to the Royal Society of South Africa. Mr. C. Van Riet Lowe, who announced the discovery, stated that the stone implements were found during exploration at Mazeppa Bay, near the mouth of the Kogha River. The implements are numerous and are said to be of a kind hitherto unrecorded in scientific data. It appears that they represent a distinct stage in Stone Age industry. Some of the implements are long, blade-like shapes. Some are scrapers, gravers and points, but the most characteristic specimen is like a giant crescent.

THE first known specimen of a cross between a moose and an elk was recently killed in the Deerlodge National Forest, in Bear Gulch. The animal, known to United States forest rangers as "the elk with the funny horns," associated with elk and grazed like them, but had a body and horns that were half moose and half elk. He was first seen on the Boulder Creek District of the Deerlodge Forest when about three years old, judging from his appearance. When killed, the animal weighed 1,100 pounds.



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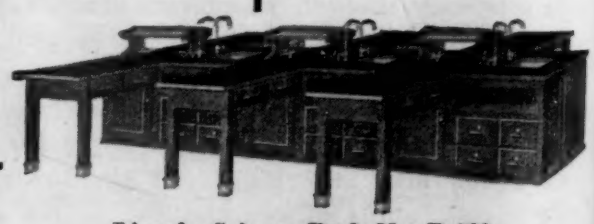

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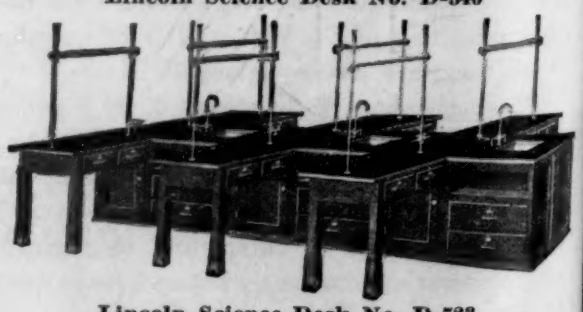

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SCIENCE NEWS

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A NEW COMET

A NEW comet, visible to the naked eye, is in the early morning sky. It was discovered by Percy M. Ryves, an English amateur astronomer resident in Zaragoza, Spain, who reported his discovery to Harvard College Observatory asking for confirmation. Harvard notified Yerkes Observatory, and Professor G. Van Biesbroeck, at Yerkes, observed it as faintly visible to the naked eye at dawn. It has a short tail. Its exact astronomic position on the morning of August 14 was right ascension eight hours four minutes thirty-two and a half seconds and declination north twenty-two degrees twenty-four minutes forty-six seconds. Professor Van Biesbroeck found it difficult to photograph the new comet as no long exposures were possible.

"Ryves' comet, which is new and the brightest in several years, was probably found with the naked eye," Dr. Harlow Shapley, director of the Harvard College Observatory, explained.

The new comet is in the constellation of Cancer and is moving northeastward. It now rises one and a half hours before the sun.

As the brightest comet to be observed since 1927, the new comet will be observed widely. In December, 1927, Skjellerup's comet was observed in full daylight near the sun. Though a number of other comets have been observed since then, all have been so faint as to require a telescope to see them.

As soon as three observations of the new comet are obtained at different times, it will be possible to calculate the orbit in which it is moving. It may then prove that the comet is getting brighter and that it will be a conspicuous object in the night sky. On the other hand, it may have already passed closest to the sun and now be decreasing in brightness. Calculations of its orbit will be made at the University of California, the chief center for such work.

Ryves' comet is fourth magnitude, which means that it is of such brightness that except for its closeness to the sun it would be easily visible to the unaided eye.

The latest comet discoverer, Percy Mayow Ryves, is an experienced variable star observer who has a five-inch refracting telescope and a ten-inch reflector at his private observatory in Spain.

FLEAS AS CARRIERS OF TYPHUS

FLEAS, long suspected of transmitting endemic typhus fever in the United States, have at last been convicted of the offense by conclusive evidence, according to a report of the U. S. Public Health Service. The proof that rat fleas are a transmitting agent for the disease was obtained by laboratory tests.

For months, Drs. R. E. Dyer, A. S. Rumreich and L. F. Badger, of the U. S. Public Health Service, have been working on the case, to determine once and for all whether fleas were responsible for spreading the disease, or whether some other agent should be sought. In Europe and Asia, typhus is spread by the body louse, but cases in the United States have occurred where no such source of infection was possible.

In February, the doctors reported that their experiments had reached a point at which it seemed almost certain that fleas are typhus carriers. Now, that belief is confirmed. The proof was obtained by injecting white rats with the virus of endemic typhus, and then putting fleas on them. Six of these fleas were later emulsified and injected into two guinea-pigs. Both guinea-pigs developed the symptoms of endemic typhus. Other fleas from the infected rats were placed in a new box containing some white rats infected with typhus and some non-infected. In two weeks, one of the rats that had not had the disease was killed and fleas from its body were again treated and injected into guinea-pigs, and the disease developed in the guinea-pigs. Other experiments added to the evidence of the rat fleas as the carriers.

SUGAR IN AMBER

SUGAR that has been aged in amber for scores of thousands—possibly hundreds of thousands—of years, and is yet fresh enough to supply food to living plants, has been studied in Berlin by Professor Dr. Johannes Gruss, well-known German researcher on the evolution of yeasts and fungi.

The microscopic traces of sugar were always found in connection with insects that had been trapped in the amber while it was still oozing from the pines on the ancient Baltic shores, as a soft, sticky resin. Buried in the silt the resin slowly fossilized into amber, preserving insects, bits of flowers and chemical substances caught in its air-tight substance.

The insects responsible for the presence of sugar in the amber were always either bees or butterflies, which are honey-gatherers, or aphids, which suck sap out of green shoots and leaves and convert it in their bodies into a sweetish stuff called honey-dew, eagerly sought by ants. In their struggles as they sank into the tangle-foot resin in which they were trapped, these insects apparently exuded some of the sugar-coating fluids, which after losing their water through evaporation remained as nearly pure sugar.

The amber specimens examined by Professor Gruss were all of Tertiary geologic age, and he estimates them to be from 60,000 to 80,000 years old. This estimated age will be regarded as exceedingly conservative by many geologists, who are willing to accept a time period as great as a million years since the close of the Tertiary. Whatever may be their age in years, Professor Gruss' sugar samples are probably the oldest sugars yet discovered.

However, old as they are, these sugars have shown themselves to be quite serviceable as food. Many of the

amber sections which Professor Gruss was examining at the Berlin Museum of Natural Science became mouldy with two species of fungi feeding on the contained sugar. One of the species was new to science, and has been named *Cladosporium circinalis*. This mould grew only on the sugars left in the amber by perishing aphids.

Professor Gruss, who attracted attention some time ago by studies of yeast cells in 4,000-year-old Egyptian beer jugs, was hunting for yeasts still older when he began his researches on amber. He found them in great abundance. Most of them were flower-yeasts, found then as to-day mainly in the nectars of flowers, and carried from one flower to another on the mouthparts or heads of visiting insects.

These ancient flower yeasts were very similar to their modern descendants, tending, however, to be smaller in size and simpler in organization. As adaptations to insect travel, they formed their chains of cells into crosses, anchors and other figures that would catch and cling to the insects' hairs. Besides the true flower yeasts, Professor Gruss found a number of other yeast species and several moulds.

COCHINEAL BUGS TO DESTROY CACTUS

COCHINEAL bugs are used to destroy cactus clumps that harbor dangerous snakes in southern India. The bugs were imported by C. T. Jacob, as an experiment.

Two months or more after the insect has been set to work, the cactus plant begins to show the effects, and puts on heroic efforts to bear fruit. But it collapses instead. After that, Mr. Jacob noted that the insects breed mostly males with wings. Female cochineal has no wings. The insect, too, shows very safe tastes. Grass and weeds that spring up immediately where the cactus died are untouched by the insect pest.

Cactus and cochineal both are native to America, probably to Mexico, for there more species of the plant are found than in any other place. Before the Spanish Conquest of the New World the Aztecs of Mexico raised cochineal on cactus for dyes. The natives still use it in places to-day. The Spaniards took it to the Canary Islands, and ran a very profitable business there, until the Germans discovered aniline dyes in modern times. Other countries had imported the cactus, too, for the same reason, but in some cases with disastrous results.

In Europe cactus did no harm, but in Australia it has infested great grazing areas, and in South Africa, too, it is becoming a problem. The fact is conditions were too ideal for its propagation. The natural enemies of the genus did not exist in Australia and other places as they existed in America. In Mexico, land of the cactus, it has reached a nice biological balance with its natural enemies.

One of these enemies is the cochineal bug. The species *Dactylopius tomentosus* is the one that has now been imported into South India. The cactus that it fights there is the *Opuntia dillenii*, which forms the lair of dangerous snakes.

The cochineal bug is a soft-bodied scale insect. It is covered with a fine white down made of sticky white threads. The insects are very prolific and breed about a generation a month. On hatching, the tiny "crawlers" wander over the plant, and when they find a favorable spot they sink their tiny trunks into the cuticle of the plant and stay there the rest of their lives. Their legs seem to atrophy, and if the insect is removed it dies.

It is believed by the feeding alone, the insect could not wreak such havoc with the plants. Mr. Jacob suggests that it may introduce a virus into the cactus, or a bacterial disease. The fact that on the death of the plant, the insect suddenly begins to breed large quantities of males, is very curious too. It is as if it were a consequence of starvation, or of a changed composition of the juices of the plant.

DROUGHT CENTERS

DROUGHT has shifted its center this year. In the central valleys of the country, where last summer a continual blazing sun made conditions the worst, rain now falls; and this time in the northwest, unyielding skies have been seen the longest. But the stricken area is less than was the drought focus of 1930, according to Joseph B. Kincer, of the U. S. Weather Bureau, and the country as a whole is faring better.

Montana, Minnesota and the Dakotas, after experiencing their dryest winter, have been getting a double dose of heat and lack of precipitation. Since January 1 the rainfall in these states has been about a third below normal. For the six-month period, figures from the U. S. Weather Bureau show, North Dakota averaged 60 per cent. of the normal rainfall while for the same period in 1930 its average was 92 per cent. normal. For Montana the average is 51 per cent. during the past six months as compared with 73 per cent. normal for the time last year.

That the drought is serious in the north central and western states, is shown by the fact that for the month of July alone 200,000,000 bushels of the nation's corn crop have been lost. Heavy drops, ranging from 4 to 137 million bushels, have also been reported in July for oats, barley and other small crops, while the decrease in the spring wheat yield is the greatest on record.

In contrast to these losses, Arkansas, probably the worst sufferer during last summer's dry spell, is having bumper crops—twice as much cotton as last year—and the rainfall average has jumped from 19 per cent. of normal for July, 1930, to 157 per cent. of normal for the same month this season!

Pasture lands are feeling the grip of the present drought most keenly. From Ohio westward, Mr. Kincer says, at least a third of the states have the poorest or next to the poorest pastures on record. As the center of this summer's drought area, South Dakota has the poorest in the state's history, and with the exception of two or three states in the past, is harder hit in respect to pastures than any other state in the country in any year.

Mr. Kincer explained that in its entirety the United States was not suffering from the drought as much as during last year because the drought center is consider-

ably smaller this year and because the rains, though few in comparison with normal years, have been well distributed and have come at intervals necessary to keep crops in general from failing.

"As a result of last year's drought," he said, "which removed practically all of the soil water, crops have had to live a 'hand-to-mouth' existence from one rain to another."

It was also pointed out by Mr. Kincer that the dry conditions at present are but a continuation of last year's rainless weather, inasmuch as in only three of the past 17 months has rainfall for the country been as much as normal. The expression "normal," he stated, meant an average in rainfall for the last fifty years or so.

One factor that has made the area including the Rocky Mountains and westward drier now than last year was the absence of appreciable snowfalls during the past winter. This has lessened considerably the amount of water for irrigation.

CALENDAR REFORM

THE State Department may soon make an announcement regarding an official delegate from the United States to attend an international conference on calendar reform in Geneva in October.

The calendar reformists led by George Eastman, retired president of the Eastman Kodak Company, want thirteen months instead of twelve, each with twenty-eight days; or else twelve months neatly catalogued into four quarters of 91 days, 91 days, 91 days and 92 days, respectively.

It seems somewhat questionable at this time, however, as to whether the world wants its calendar to be reformed. Unofficial collections of opinion in various countries, through the medium of questionnaires sent to clubs, business organizations, and so on, have seemed to indicate that only in Germany and the United States is there marked enthusiasm for the venture. Switzerland, too, is inclined to favor it. Marked public apathy is reported in Portugal, France, Great Britain and Italy, according to the report just released of the Preparatory Committee on Calendar Reform which met in Geneva last June to prepare a basis of discussion for the conference in October.

The United States had a delegate at the meeting of the Preparatory Committee—Dr. Charles F. Marvin, chief of the U. S. Weather Bureau, who is known to be as enthusiastically favorable to a calendar reform as George Eastman himself. But Dr. Marvin at that meeting did not officially represent the United States nor in fact did any of the other committee members represent their governments. The committee expressly stated that the members did not look upon themselves as spokesmen of the whole public opinion of the countries from which they came.

When official delegates are appointed, however, and meet with the Transit Committee of the League of Nations on this problem, their words will be watched because it will be assumed that they speak with authority and will be backed up at home in the stands they may take on whether there should be a new month interposed between June and July to be called by the solemn name of "Sol," or given some other designation.

Many of the big, powerful countries of the world are interested, but think we are doing very well as we are and that any change should be made very cautiously and not until it is clearly shown to be highly desirable. On one point almost universally the countries believe a change would be beneficial; the establishment of a fixed date for Easter.

While Congressional action for the appointment of a delegate from this country to the October Geneva conference is unnecessary, any action taken in regard to a new calendar would have to be ratified by Congress to be effective.

ITEMS

WESTERN China was the location of a severe earthquake on Monday (August 10) afternoon at 4:18 P. M., E.S.T., seismological reports wired *Science Service* and interpreted by the U. S. Coast and Geodetic Survey indicate. The center of the disturbance which may have killed many people was in the Sinkiang Province of China on the west edge of the Gobi Desert, an area sparsely settled and remote from communication lines. It may take weeks for news of the actual damage done to reach telegraph lines. Seismographs all over the world vibrated for hours with this shock which was one of the most severe of the year. The longitude and latitude of the epicenter as determined by the U. S. Coast and Geodetic Survey was 90 degrees east and 42 degrees north.

THE U. S. Coast Guard's oceanographic vessel, *General Green*, has returned from a four thousand mile cruise between Labrador and Greenland. Observations of temperature and salinities were made at 122 points in six crossings of the Labrador current and two sections between Labrador and Greenland. These measurements were taken in thirteen levels down to depths of two thousand meters (six thousand feet). More than seventeen hundred soundings were taken. On the Labrador coast about one hundred icebergs were sighted. Hundreds of bergs must be grounded and are disintegrating along the coast. Hudson Strait is free of ice, only three bergs being sighted. Remnants of pack ice and about five hundred icebergs were sighted between Ivigtut and Cape Farewell, on the south tip of Greenland. Of all the bergs seen, only two were more than sixty miles off shore.

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Science Service, Washington, D. C.

THE NEW COMET

RYVES'S comet, discovered by an English amateur astronomer living in Spain, will probably be visible low in the western evening sky, just after sunset, for a few days. Mr. L. E. Cunningham, of the Harvard College Observatory, has made a preliminary computation of its orbit. This indicated that the comet would be at perihelion, or closest to the sun, on August 25.

After that, according to the computations, which are admitted to be somewhat uncertain, it will be in the constellation of Leo, and of the minus 3.4 magnitude. This is almost as brilliant as Venus at its brightest, and brighter than any other permanent astronomical object except the sun and moon. At that time it will be about seven degrees from the sun, and may be even visible in broad daylight. At noon when the sun is directly south, it should be seen to the left of and a little below the sun, if that body's direct glare is obscured behind the edge of a building or in some similar way.

Incidentally, this position is only about three degrees away from the position of Nagata's comet when it was discovered by a Japanese amateur astronomer in California a few weeks ago. Then, however, the sun was considerably farther away.

Mr. Cunningham's computations of the orbit are based on observations of Ryves's comet made on August 14, by Dr. George Van Biesbroeck, of the Yerkes Observatory, Wisconsin, and on August 15 and 17 by Dr. E. C. Bower, of the Lick Observatory, California. Three separate positions of a comet are necessary to determine its orbit. However, if the three are very close together, as was the case with those used by Mr. Cunningham, any slight error is greatly magnified. Only by using three observations spread over a wide arc of the comet's orbit can really precise computations be made. For this reason, Dr. Harlow Shapley, director of the Harvard College Observatory, in announcing Mr. Cunningham's results, states that further observations of the comet are urgently needed.

Though the present computations are very uncertain, they should permit the comet to be kept in view. Without them it might be completely lost, as has happened in the past.

ELECTRONS AND THE BLUE OF THE SKY

ELECTRONS streaming from the sun may be the cause of our familiar but mysterious blue sky, Dr. Willi M. Cohn, of the University of Berlin, has concluded as the result of his experiments in which a blue light very similar to that from the sky was produced in the laboratory. Dr. Cohn is engaged in high temperature research at the A. D. Little laboratories at Cambridge and will start researches at Harvard in the fall.

Dr. Cohn experimented in Berlin with cathode rays in a high vacuum, formed in a tube similar to the x-ray tube. He allowed the stream of electrons, which is the cathode ray, to meet larger electrically charged particles of matter, known to scientists as ions, which are formed either from a piece of radioactive metal, such as thorium, or from a gas. The blue light appeared where the electrons and the ions came together.

This blue light can be broken up by prisms to form a spectrum or "rainbow" of continuous color, just as is found in sunlight. The blue light from the clear sky also shows a continuous spectrum, although gases, such as the air this light passes through, have quite different spectra showing only thin colored lines. Dr. Cohn points out that at the upper layers of our atmosphere, electrons continually arriving from the sun and ions of the gases which form our air meet in the intense vacuum of space. Since under such conditions in his laboratory the blue light which is so like the light from the blue sky is formed, he believes that the blue of the heavens may, at least partially, have the same cause as that of the laboratory.

Since the time of Newton investigators have speculated on why the sky is blue. The most successful explanation heretofore has been that of Sir John Tyndall and Lord Rayleigh in the last century, which considers it due to sunlight broken up in a particular way by spherical particles in the atmosphere. Dr. Cohn states that his theory does not conflict with the older one so far as direct sunlight is concerned. He points out that the Tyndall-Rayleigh theory would expect the light from the sky to be polarized so that all its waves would vibrate in a particular way. The light produced by Dr. Cohn in the laboratory is not polarized, and daylight is only partly polarized, partly not.

TREATMENT FOR HOOKWORM

A SAFE and apparently certain treatment for hookworm has been found in the synthetic antiseptic hexylresorcinol. This important discovery in the field of medicine was announced by Dr. Veader Leonard, of the School of Hygiene and Public Health of the Johns Hopkins University, before the Section on Tropical Medicine of the Third Pan-American Medical Congress at Mexico City.

Dr. Leonard himself first described the bactericidal properties of the drug, but not the fact that it is effective against hookworm and ascaris. Since 1924 it has been known that the synthetic chemical, hexylresorcinol, is seventy times stronger than carbolic acid, and at the same time practically non-toxic to man. It has been used as a general, as well as internal, antiseptic the last few years.

Dr. Paul D. Lamson, professor of pharmacology at the Vanderbilt University School of Medicine, discovered its potency in hookworm disease and ascariasis, while investigating the problem of safe remedies. The work was sponsored by the International Health Division of the Rockefeller Foundation.

Hookworm, the "disease of backwardness," is one of man's oldest diseases, for its symptoms are apparently

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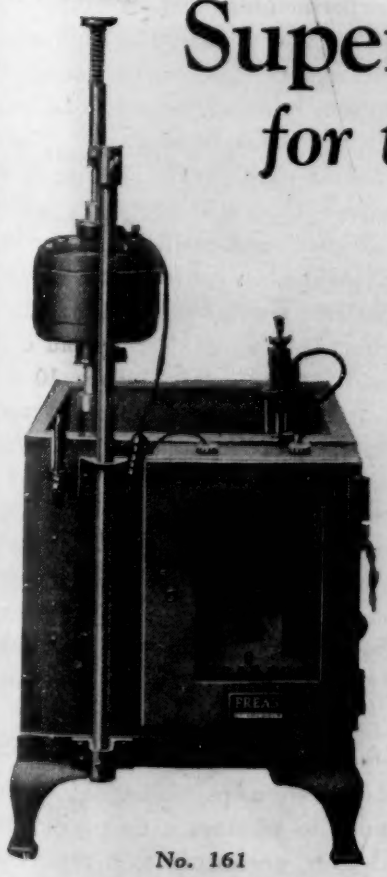

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described in ancient Egyptian papyri. In present times it is claimed that half of the world's population lives in areas where it is prevalent. Millions of people are infected by it, and the havoc it does is incalculable.

It is a disease that could be controlled by hygienic means, Dr. Leonard stated, but it is difficult to obtain the cooperation of the masses affected by it. The ignorance of the classes that generally have it is the stumbling block.

"The statement can be made without reservation," Dr. Leonard said, "that there is not a single anthelmintic (anti-worm) drug now in common use, which has not caused prompt fatalities by the administration of average doses." Because of its dangers, the use of thymol has been largely superseded by carbon tetrachloride, a common cleaning fluid. But carbon tetrachloride may prove fatal in small doses to persons deficient in calcium.

Santonin, a classic remedy for ascariasis, infection by common roundworms, is one of the most expensive drugs in the pharmacopeia, and may produce serious poisoning in very small doses, while it may be fatal in average doses. Oil of chenopodium, given in place of this drug because of its expense, has to be given with care to debilitated persons. Many fatalities have occurred, for its toxicity varies and it has never been standardized.

The problem in America, Dr. Leonard says, is largely a matter of the control of the two parasites—hookworm, and ascarids or common round-worms. Both carbon tetrachloride and oil of chenopodium are specific against only one of these parasites, while many patients have both. Treatment with carbon tetrachloride is sometimes dangerous. While it may kill the hookworms, it irritates the ascarids and causes them to begin a migration to escape the drug which may be fatal to the patient.

The new drug, hexylresorcinol, is effective against both parasites, and against even a third, Trichuris trichiura. The chemical is easy to take, has no bad after-effects, and seems to be one hundred per cent. efficient when directions are followed. It is effective in this instance only in its crystalline form, made into sugar-coated pills. Four tenths of a gram is enough for children under six, while one gram is enough for persons twelve or over. It must be taken on an empty stomach and no food should be eaten for four hours afterwards.

Dr. Leonard does not yet know whether this drug will be as effective against European hookworm as against the American, or less so, as is true of carbon tetrachloride. It is not known whether it will be useful against other nematodes parasitic to men, and cestodes. Present results are based on experiments made with about 1,500 persons in the United States. Other investigations now on foot in Japan, China, the Philippine Islands, India, Siam, Egypt, the southern part of the United States and Mexico may answer these questions.

RINGWORM INFECTION OF THE FEET

A COMMON chemical used in purifying city water supplies, sodium hypochlorite, has been found by two Buffalo workers in medical research, Dr. Earl D. Osborne and Miss Blanche S. Hitchcock, to be an effective preventive of ringworm infection of the feet. This disease, also known as "athletic foot" and similar nicknames, has spread spectacularly with the post-war rise of sports involving the use of common dressing-rooms and other gathering-places where athletes trample around barefooted for a time. There the spores of the fungi that cause the disease are spread from foot to foot, later causing irritation, cracks and itching watery blisters.

Dr. Osborne and Miss Hitchcock state in their report to the official publication of the American Medical Society that they have not been able to find a record of sodium hypochlorite being used or suggested as a fungus-killer before. They made some preliminary trials with cultures of various fungi in test-tubes, using solutions of the chemical in concentrations stepped up from one thousandth of one per cent. to one half of one per cent. The latter concentration seemed the most effective and was chosen as standard for a clinical trial.

With the cooperation of the physical training department of the Buffalo high schools, heavy rubber pans were installed in all the gymnasiums, and students going to and from gymnasium classes were required to wash their feet in a one half per cent. solution of sodium hypochlorite. The solution was renewed every day. In a new high school a shallow "well" for the solution was built into the corridor passing from the dressing room to the showers. Later, the strength of the solution was increased to a full one per cent. because of possible dilution through use.

The results of the experiment are reported as most encouraging. The spread of the infection was completely checked. The two experimenters report that "the records fail to show a single new case, although numerous ones have appeared from the surrounding towns."

The hypochlorite solution, however, is not to be looked upon as a cure for already established cases. The report continues: "So far as cure of the disease is concerned, we do not believe that 0.5 per cent. solution hypochlorite or even 10 per cent. sodium hypochlorite would be any more efficacious in curing an established case than any other methods employed at present in the treatment of this stubborn condition."

The sodium hypochlorite treatment is the second efficacious prevention for ringworm of the feet reported recently. A short time ago Dr. W. L. Gould, of Albany, N. Y., described how he had stopped the spread of the disease in the junior high school there with a 10 to 15 per cent. sodium thiosulphate solution. Dr. Osborne and Miss Hitchcock, however, believe that their sodium hypochlorite solution offers certain advantages. It is cheaper, and when the quantities used in gymnasiums and similar places are considered this is a distinct consideration.

PSYCHOLOGICAL TESTS OF AVIATORS

PERSONALITY, as shown in a psychological examination, is an excellent index to whether a man will "make the grade" as a naval flyer, according to a report made by Lieutenant C. G. De Foney, of the U. S. Navy Medical Corps, in the *Medical Bulletin*.

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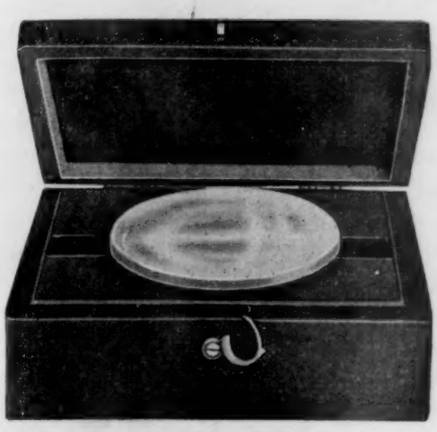

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"The highly intellectual individuals, the bookworms and grinds who had previously reported for training at Pensacola had not done so well as a group; a very low percentage of this type complete the course. This is easily explained, since this type of individual is usually the poorly rounded out personality, the poor mixer, the introspective, overly serious, sensitive individual who enlarges on the possibilities of danger and failure. This type fares poorly under the present system of trial flights at frequent intervals with a check pilot.

"It has also been noted that the mentally dull, self-satisfied, extraverted individual does much better here for the opposite reasons that he is either too dull to know when he is in trouble in the air, would not admit it if told that he was and is not thinking of the future or possibilities; he lives only in the present moment and hence is relieved of the mental load that the previous type mentioned carries.

"This second type, however," according to Lieutenant De Foney, "being indifferent to dangerous situations and possibilities, is the careless flyer who is always having real or near collisions in the air, beach crashes, grandstanding for the crowd's applause, and causing much repair work on previously good airplanes."

Of the men selected on the basis of psychological examination as being good aviation material from the standpoint of intelligence and emotional make-up, only 30 per cent. failed to make good. Of those set apart as being poor material only 32 per cent. were able to qualify and nearly half these required extra instruction. The crash rate is more than double among those called poor aviation material than among those who did well on the psychological examination.

ITEMS

WITH the new dirigible, *Akron*, soon ready to give more definite test to the practicability of trans-Atlantic air travel, the vicinity of Richmond, Washington and Baltimore is under consideration as the location of a possible terminal for such commerce. Philadelphia has also been included in the group as being the most northerly point in the suitable area. The locality of these four cities was recommended by Ward T. Van Orman, of the Goodyear-Zeppelin Corporation, builders of the *Akron*, after a thorough investigation of weather conditions along the Atlantic seaboard. The U. S. Weather Bureau cooperated in obtaining for him the necessary climatological and meteorological data. At present, devices to measure wind speed and direction have been erected at these cities and the resulting records will determine largely which one is to have the new air harbor.

POLLUTION of inland and coastal waters in the United States as a whole is decreasing. Twenty-five of the forty-four states questioned by the joint committee on oil pollution of the American Engineering Council reported an improved condition. In eleven states oil pollution was believed to be on the increase, while in six states the question was regarded with doubt.

THE largest living thing on earth is the General Sherman sequoia tree in Sequoia National Park. A committee of engineers has completed precise measurements of the big trees of California and has awarded the championship to this tree, with the General Grant tree second. Over a thousand observations and calculations with precise engineering instruments, showed that the General Sherman giant redwood has a volume of 600,120 board feet, a height of 272.4 feet, a circumference at the ground of 88 feet and one limb alone has a diameter of 6.8 feet. The General Grant tree contains only nine tenths of the volume of the General Sherman tree but it is larger around at the base, higher and probably older. The giant sequoias are considered the oldest living things on earth, having ages estimated to be 4,000 to 5,000 years.

TIMBERS placed atop untreated pine piles saved the day along a two-and-a-half-mile stretch of swampy North Carolina land where the concrete road had sunk so far as to be impassable. The novel timber bridging was constructed directly over the old roadway. Spaced ten feet apart, the piles were driven deep into the oozy mud in lines on both sides of the old roadbed. Caps made of concrete encased the tops of the piles in order to provide a firm basis for the timber decking. A layer of asphaltic concrete covered this decking of the emergency road. While the piles were being driven it was still possible to leave a minimum of 13 feet of the old road open to traffic.

How does the pigeon find his way home? Many of the theories heretofore advanced involve the idea of a special sense of direction, but experiments conducted by Dr. Ralph H. Gundlach, of the University of Washington, indicate that the correct explanation is probably that these birds have good vision, wide cruising range and some special motivation. Dr. Gundlach constructed a maze in such a way that only a creature having a directional sense would be able to solve it. The experienced homers tested showed no sign of reaching a solution even after three months of trial. Another test was to release 16 trained racing homers on a course lying in a direction from home different from that of the course on which they were trained. These racers were accustomed to covering 100 miles in two hours on their home course. On the new one in which they had to find their way only three came home in less than five hours. Six were out from one to 14 nights, and two never came home at all.

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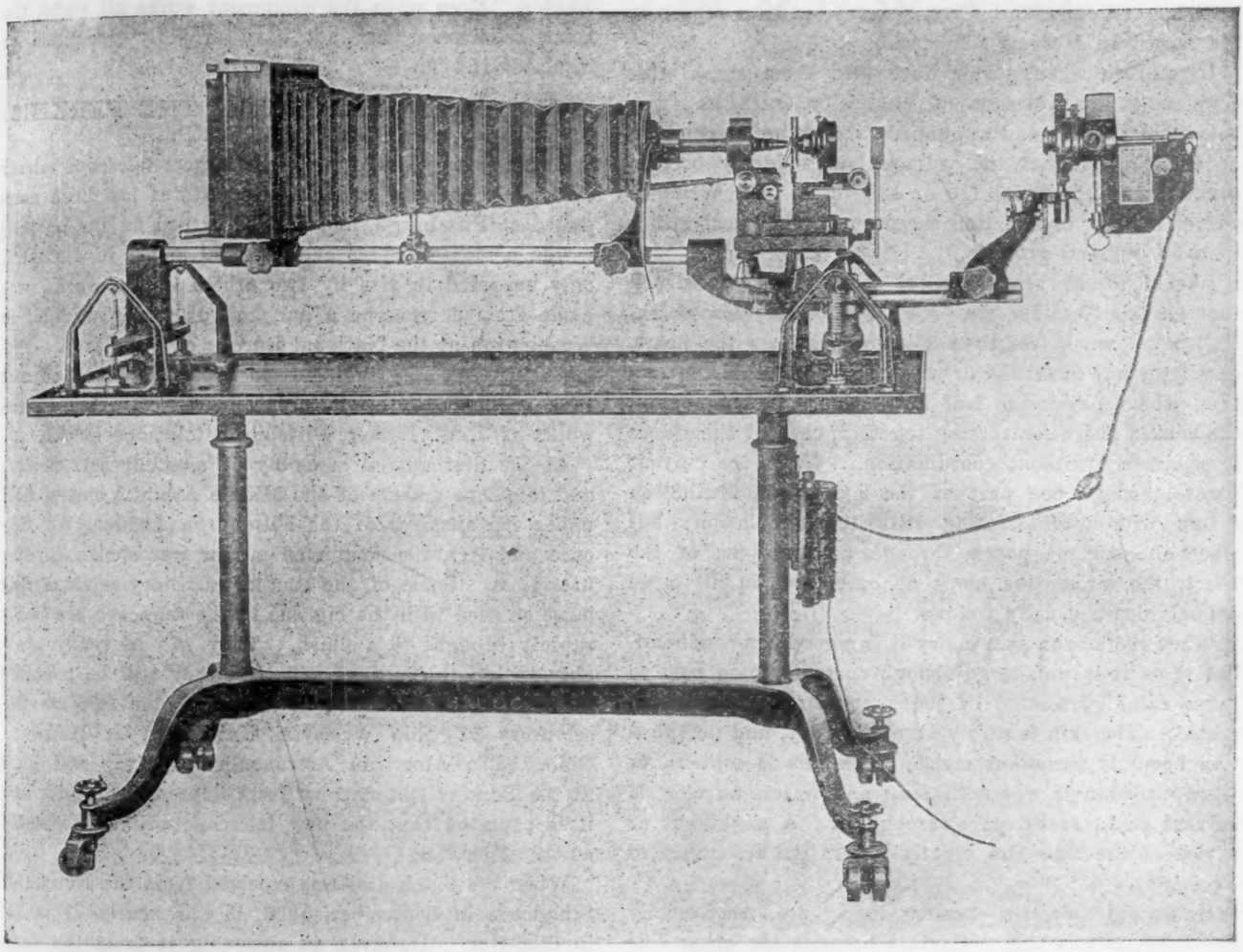

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SCIENCE NEWS

Science Service, Washington, D. C.

DANGER FROM LOW VOLTAGE ELECTRIC SHOCKS

SHOCKS by electricity of even such low voltage as that found in the ordinary household circuit are extremely dangerous and may cause death, Dr. Horatio B. Williams, of New York City, pointed out in a report to the American Medical Association.

Heretofore when people have died from shock with supposedly low voltages of electricity, such as from household circuits and appliances, it has been explained on the ground that the voltage had suddenly become greater than the usual 110 or 120 volts. Dr. Williams offered another explanation based on physiological rather than on physical grounds.

Within recent years medical scientists have learned that electricity under the pressure of a very low potential, often much less than 110 volts, affects the heart, causing a sort of tremor or wavering in its usual contraction, which physicians call fibrillation. Instead of all the muscle fibers contracting together, each of them does it separately without coordination. When the current passes through one part of the heart, this fibrillation occurs without interfering with the circulation; but when the current passes through another part of the heart, the circulation stops at once, and in all large animals death usually follows.

When the human skin is dry it is a good non-conductor, but when it is wet, large enough currents could pass to cause fatal fibrillation of the heart, Dr. Williams suggested. The skin is rarely absolutely dry, and perspiration keeps it somewhat moist; when this is copious, or when the skin is wet with soap and water, an electric current could easily pass through it. A slight cut or bruise of the skin also greatly lowers the resistance to electricity.

Household electric power lines are customarily grounded on one side. Contact between the other side and any part of the body becomes dangerous when the skin is wet enough to conduct. Water pipes, drain pipes, radiators, sinks and the conduits in which the power wires run are all usually well grounded. This, together with the fibrillation theory, explains the numerous cases of fatal electric shocks of persons touching electric appliances while in the bathtub, for instance.

"A person in a bathtub, making through his wet skin an excellent contact with the grounded drain pipe, runs a deadly risk if he happens to touch the metallic shell of a fixture which is in electrical contact with the ungrounded side of the circuit," Dr. Williams said. "Fixtures are not supposed to be in this condition, but there are so many opportunities for them to be or to become so that the danger is ever present.

"It may be dangerous to touch electric lamps and appliances with wet hands, especially when there are cuts and abrasions of the skin and particularly when there is a ground contact, as when one is in a bathtub."

Another danger spot is the chain pull switch with which many lamps are equipped. In some there is an insulating link, but many do not have this. A safe practice is to tie a piece of silk ribbon to the chain, particularly in the bathroom, kitchen and cellar. Home repair of electrical equipment may also be a source of danger. Even when the equipment works all right, the home repairman may not have properly grounded or insulated it.

TELESCOPE MIRROR FOR THE PERKINS OBSERVATORY

AFTER three years of work, the largest telescope mirror ever made entirely in the United States has been completed at Pittsburgh, and will be turned on the heavens within a month. This huge eye, 69 inches in diameter, only exceeded in size by two others in the world, was made from a two and a half ton disc of glass cast in Washington at the National Bureau of Standards. The laborious task of grinding it to a perfect curve, correct to a millionth of an inch, has been performed in the works of J. W. Fecker, Pittsburgh telescope maker.

At the first annual assembly of amateur astronomers and telescope makers of the Middle Atlantic states, held under the auspices of the Pittsburgh Academy of Science and Art, the completed mirror was shown for the first time. Some of the smaller auxiliary mirrors that must be used with the big one in the telescope are being rapidly brought to a finish. They will be ready probably within thirty days and then they will be mounted in the 69-inch reflecting telescope of the Perkins Observatory of Ohio Wesleyan University, at Delaware, Ohio. The American Astronomical Society will meet at the Perkins Observatory from September 7 to 9, and it is expected that the new telescope will be dedicated at that time.

When the blank disc was received from the Bureau of Standards in September, 1928, it was nearly 71 inches in diameter. However, in removing it from the form in which it was cast, several large pieces had been chipped from the edge. In order to secure a clear surface it was necessary to reduce the size nearly two inches, and to remove about 1,100 pounds of glass. In its completed form the mirror weighs 3,790 pounds, and is 10 5/16 inches thick. As it is set up, thousands of small air bubbles can be seen inside it, as well as numerous striations, or regions of slightly different density. But a telescope mirror, unlike the usual looking-glass, is silvered on the front surface, and the glass acts merely as a support. Therefore, these irregularities will not affect the performance of the instrument.

The glass has been ground to a concave shape. When in use, it will face the stars, and their light rays will be focused on a smaller concave mirror above it, which will return the rays, through a hole in the main mirror, to an eyepiece or photographic plate, depending on whether the telescope is being used visually or photographically.

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A total of 15,860 hours of work has been required to complete the mirror, Mr. Fecker said. In addition, many hours of waiting were necessary while it cooled to normal temperature for testing, after the grinding operations had warmed it. Its figure is now so accurate that the most delicate tests reveal no error. The tests used by the optician would reveal a deviation of a millionth of an inch from the correct shape. No test that the astronomer can apply, using the telescope on a star, are as delicate, said the maker.

The only telescope mirrors exceeding this in size are the 100-inch mirror, at the Mount Wilson Observatory, in California, and the 72-inch mirror in the Dominion Astrophysical Observatory at Victoria, British Columbia. Both were made from French glass. The former was completed by Professor G. W. Ritchey, in the Mount Wilson shops at Pasadena, and the latter in the Pittsburgh shops, then operated by John A. Brashear, Mr. Fecker's predecessor.

GLACIERS

A RETURN of the great glaciers in 2,000 years or thereabouts is a reasonable expectation, according to Dr. O. Gunnar Erdtman, of the University of Stockholm. Dr. Erdtman, who recently lectured at the University of Michigan *en route* from Alberta to Sweden, bases this statement on a comparison of the postglacial forest history of northern Europe with the forest histories of interglacial periods.

The course of forest history is traced by means of the microscopic fossil pollen deposited by wind in lakes and bogs, where it is preserved in sediment or peat. If the various layers of this material are removed in order and studied, the composition of the local forests at successive times can be ascertained. The kinds of tree pollen and their relative abundance furnish the clue.

An interglacial period is marked by the retreat northward of coniferous forests of fir, spruce and pine. This is accompanied by the development of a warm, generally dry climate and the advance of deciduous forests of oak, beech and other trees, from the south. After a time these deciduous forests retreat southward, followed by the conifers, whose shift presages the return of the ice.

The evidence so far secured by Dr. Erdtman in Scandinavia and the British Isles strongly suggests that a southward movement of the forests is under way. Certainly it is known to scientists in both Europe and America that the present climate is more humid, and probably cooler than was that of a few thousand years ago. It is also known that deciduous forests were more extensive in southeastern Canada a few thousand years ago than they are to-day. On the basis of such facts it may not be unreasonable to regard the present period as properly interglacial, rather than postglacial. Such a possibility is often mentioned by geologists on other grounds.

Dr. Erdtman has just completed several months as a guest of the University of Alberta at Edmonton. During this time he made extensive studies of the pollen being deposited to-day in the muskeags and lakes of the northern interior, to see how accurate a picture it presents of the existing forest. In this way it is hoped to learn how much dependence may be placed upon fossil pollen as an index to forests of the past. Dr. Erdtman has found the problem complicated by the fact that certain very abundant trees, such as aspen and poplar, have pollen which is not preserved. This is not likely to affect the general conclusions reached in Europe, however.

STEVIOSIDE

A NATURAL substance 300 times sweeter than cane sugar, rivaling some of the coal-tar products of chemical laboratories, has been shown by two French chemists to consist of a chemical union of common glucose and another compound which has little or no taste. United, they are intensely sweet; divided, they are not even as sweet as ordinary sugar.

The compound bears the chemical name "stevioside," because it occurs in a South American plant known to botanists as Stevia. The plant itself was first introduced to the scientific world about the beginning of the present century; it is a close relative of such familiar North American weeds as boneset, Joe Pye weed and the plant that causes occasional outbreaks of milk sickness in the Midwest. After its discovery by Europeans it rapidly acquired the name of "the sweetest plant in the world." A very small piece sufficed to sweeten a cup of coffee or tea.

During the past generation several partially successful attempts have been made to isolate and study the particular substance in the plant that made it so intensely sweet. It has remained, however, for the French chemists, MM. Briddel and Lavielle, to accomplish the final purification.

They have discovered, to their surprise, that the sweet crystals of stevioside, upon chemical treatment to remove a part of the combined water in them, break apart into about 60 per cent. common glucose and 40 per cent. of a new stuff which they called "steviol." The latter has no taste, but combined with the glucose it produces a most poignantly sweet substance.

MM. Briddel and Lavielle made another interesting discovery, the significance of which is not yet clear. If they freeze a 50 per cent. solution of the intensely sweet stevioside they obtain a mat of fine needle-crystals, which contain more chemically combined water than the original substance, and which are only faintly sweet. The sweetness of stevioside seems to depend on the presence of an exact amount of water in combination with the glucose and steviol; a trifle more or a trifle less spoils the effect.

IDIOT CHILDREN

To say that an idiot child has a mental age of two years or three years is somewhat misleading, according to a comparison between the abilities of idiot children and of normal infants of the same mental age, made at the Training School at Vineland, N. J., by Dr. Edgar A. Doll and Cecelia G. Aldrich.

Although the total mental test scores of the idiots

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ANNUAL SURVEY of
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Clarence J. West

chairman of the committee of the Division of Chemistry and Chemical Technology of the National Research Council.

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and the infants with whom they were compared came out about the same, the individual abilities and disabilities were very different. All tests involving language ability put the idiot children at a great disadvantage, but, on the other hand, tests requiring manual dexterity showed the idiots to be far superior in this respect.

"The difference in physique is immediately apparent," the scientists comment in their report to the *Journal of Genetic Psychology*. "The normal child, barely out of his infantile walking stage, and babyish in appearance, presents a picture quite different from that of the idiot child, whose physique, although immature and underdeveloped, nevertheless has outdistanced his meager intelligence. The reaction of adults toward the individuals of the two groups is for this reason alone quite different, and in turn elicits from them a different response.

"Another marked difference is in the amount of spontaneous activity of the two groups. The idiot child will very often sit patiently through a complete examination, sometimes pointing to certain tests and frequently distracted, but easily brought back to the task in hand. On the whole, the examination may continue systematically. The normal infant, on the other hand, must frequently be enticed into cooperation, and his interest must be held throughout to avoid discontent and the familiar question, 'Where's mama?'

"The normal children seemed to recognize their own limitations more quickly than did the idiot children. Once having found a task too difficult, no amount of urging could persuade them to continue their efforts. The idiot child, however, could often be urged to continue trying regardless of the apparent futility of his efforts. The manual superiority of idiot children leads to the expectation of training possibilities."

ITEMS

Two new game reserves in South Africa have been established by the Parliament of the South African Union. The largest of these lies between the Aub and Nossob rivers in northwestern South Africa, formerly German Southwest Africa, and has an area of about 1,800,000 acres. Here the gemsbock or oryx, entirely exterminated in other parts of South Africa, still lives in large herds; and there are other kinds of antelopes, including koodooes, elands and gnus or hartebeests, as well as lions and leopards and rare birds. The second reserve is called the Addo reserve. It has an area of over 11,000 acres and lies in the eastern part of the Union. It is the last refuge for a few of the South African elephants, which are much smaller than those of Central Africa. There are 40 of these now on the reserve, and the government has taken care to provide sufficient watering places for them. Lack of water has been one of the causes of their extinction elsewhere. These new reserves are cared for by the South African National Park Department, which also administers the Kruger National Park, perhaps the greatest game reserve in the world.

WITH the age-old hills of Santa Fé as a perfect setting, the new Laboratory of Anthropology, endowed by John D. Rockefeller, Jr., was officially opened to students on September 1. From all parts of the United States men and women engaged in anthropological studies trekked to Santa Fé to attend the opening exercises and to take part in the three-day conference of archeological field workers convening in the new building on September 2, 3 and 4. For many years Santa Fé has been a rendezvous of men and women interested in the aboriginal life of the great Southwest. Consequently it is most appropriate that the first Laboratory of Anthropology ever opened in the United States should be established in the very heart of a country where students may not only excavate and study the ancient ruins but also visit the nearby pueblos and supplement their digging by catching their "archeology alive." Mr. Jesse Nusbaum, formerly superintendent of Mesa Verde National Park, who is now departmental archeologist for the Department of the Interior, is director of the laboratory.

LARGE brown patches of dead grass on Ohio golf courses and lawns are not due to the extremely hot weather but a heavy attack by the sod web-worm, entomologists of the Ohio Agricultural Experiment Station have discovered. Not a new insect, the half-inch-long black worm has been encouraged by this year's good insect weather. It lays its eggs in lawn or turf grasses and the larvae hatch in two weeks. The insect keeps away from clover, and a patch of fresh green clover plants in the dead grass is a sign of its presence. Arsenate of lead powder dusted on the grass and soaked in with water will control the pest.

WHEN Colonel and Mrs. Lindbergh, *en route* to Asia, stopped at Churchill on the western shore of Hudson Bay, they saw the terminus of a new railroad leading from the Canadian wheat lands to Canada's newest port and outlet to Europe. Churchill Harbor will soon be a thriving grain shipping center during the short summer season when ocean ships can reach the Atlantic through Hudson Bay and Hudson Strait, a route that a few years ago was followed only by vessels of exploration. The port will be opened commercially next summer, and then Canadian grains will have a thousand miles less traveling to do in reaching Liverpool by way of this route than by the Great Lakes route now largely used.

GOLDFISH can be trained to develop a tolerance for the poison of tobacco, but smokers should not therefore feel that any amount they take in is harmless after they have once acquired the habit. This is the advice of Drs. Leon Binet and C. Zamfir, French physicians. Increasing amounts of tobacco-water, made by soaking two grams of good Maryland tobacco in a liter of river water, were placed in the goldfish bowl every other day. On alternate days they got fresh water again. After 51 days the goldfish survived exposure in water so strong that it killed unprepared goldfish in an hour. After 66 days they swam in the extract straight.

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SCIENCE NEWS

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OIL FROM COAL

ALTHOUGH American crude oil is now so cheap as to be causing acute economic distress in several oil fields, the supply is not inexhaustible and chemists are looking to the day when we shall have to make gasoline and lubricating oil out of coal, as they are already doing in Germany and other European countries.

At the meeting of the American Chemical Society in Buffalo, N. Y., a series of experiments on soft coals from both eastern and western United States fields was described by Professor H. K. Benson and his associates at the University of Washington. The process consisted of subjecting coal to pressures from 2,200 to 4,200 pounds per square inch, at temperatures from 200 to 450 degrees centigrade in the presence of water vapor. The oily mixtures obtained by this procedure compared favorably with the product of European coals treated in the same way, the report stated.

We commonly think of even soft coal as pretty hard stuff. Yet coal is a jelly—a colloid, to use the strictly scientific term. Evidence to this effect was adduced by Dr. Reinhardt Thiessen, of the U. S. Bureau of Mines. Using a new ultra-power lens on his microscope, Dr. Thiessen has seen the "micellae," or ultimate visible particles that go to make up coal, and he has found them to be similar in size and shape to the micellae of plants, which of course were the raw material of coal, ages ago. The colloid nature of coal has long been suspected, but until now definite proof has been lacking.

Gas for fuel, of high heating value, has been made experimentally by two Illinois chemists, Drs. C. S. Boruff and A. M. Buswell, using a most unpromising material—"beer slop" from distillery wastes produced by industrial alcohol factories. Dr. Buswell has built up a reputation for getting gas from all sorts of waste products, such as sewage and chopped-up cornstalks.

Calcium gluconate, a new chemical of considerable industrial importance and of possible value in medicine, can now be made by an electrical process, using glucose, crushed limestone and a small amount of a bromide. Hitherto the only method of production has been a fermentation process using shallow pans of glucose solution and a special kind of fungus. The new process was worked out by Dr. H. S. Isbill and his associates, of the U. S. Bureau of Standards.

Benzoate of soda, widely used to keep foods and beverages from fermenting and spoiling, is not proof against all kinds of micro-organic activity, Drs. D. Tarvin and A. M. Buswell, of the Illinois State Water Survey, have discovered. They offered a diet of this preservative to a mixed lot of bacteria deprived of free access to oxygen. The bacteria literally ate it up.

Even the strictest teetotaler has alcohol in him, researches by Dr. Alexander O. Gettler, Joseph B. Niederl and A. A. Benedetti-Pichler, of Washington Square College, New York City, have disclosed. They found minute but definite traces of alcohol in human brains and blood, in tissues of pigs, dogs and other animals. Singularly enough, the unclean swine had the least natural alcohol in him.

INCENDIARY FOREST FIRES

THE fact that a number of the recent destructive forest fires in western states are definitely known to have been started by pyromaniacs—fiends who deliberately set fire to timber—has made significant figures from the U. S. Forest Service in Washington, D. C., which show that 1,300 of the 8,400 conflagrations in national forests last year were of incendiary origin.

Up to the latter part of last month, more than half of the total number of this year's fires in these forests, 3,600 out of 6,322, were due to man's action, whether careless or on purpose. Lightning is held responsible for the remainder of the number.

The present season is turning out to be one of the worst fire years in the history of the Forest Service. A total area of 385,168 acres has been burned over in the national forests since January 1, the latest summary shows. Three hundred thousand of these acres are in western states, and of them, Idaho is at present suffering the greatest losses.

The severity of conditions this past summer is brought out in a comparison with 1930, only 137,000 acres being burned for the whole year. So far this year, Henry Wold, of the U. S. Forest Service, told *Science Service*, more money has been spent in national forests for fire control—$2,100,000 up to August 20—than was spent all last year, and the situation is worse than in 1929, which was considered an extremely bad fire season.

Reports from the field indicate, Mr. Wold stated, that the present fires are harder to suppress than those in 1910, the worst year on record for acres burned and lives lost. The fire-fighting organization is better now, however, than at that date.

Although the number of fires that actually get started is large, few of them actually become very destructive, as the result of watchfulness of rangers. While they are still infants, they are discovered and put out. So far this year, 87 per cent. of the fires in national forests have been extinguished before they burned over ten acres. If the forest areas are burned over only once they will grow back again; if they receive a double burning, however, replanting of the trees becomes necessary.

This effective fire control is exercised by three main units, Mr. Wold pointed out, of personnel in the national forests: lookouts, rangers and "smoke chasers." Assigned to particular areas, they operate in close conjunction with each other. From his vantage point atop the tower, the lookout spots the fire, made evident by the rising smoke. He immediately reports his discovery to

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the ranger, or district chief who directs operations. The ranger delegates one of the men attached to his group to search for or "chase" the smoke.

This smoke chaser hoists a pack containing three days' rations to his back along with his pick, shovel and other fire-fighting apparatus and proceeds to move on to the location given by the lookout. It is the smoke chaser's duty to stay at the fire, once he has found it, until it has been put out, or to inform the ranger of conditions beyond his control.

Constant communication is maintained between the lookout and the ranger. If the smoke continues to rise unduly long or increases in volume, the ranger is notified and he dispatches reenforcements to the smoke spot without waiting to hear from the man there.

PILLS INSTEAD OF SPINACH

IF you have any youngsters of the spinach-refusing age, you may soon be able to offer them the stuff that spinach supplies in a form they may not like any better—a powder or a pill.

For carotene, a yellow coloring matter that is present in green leaves as well as in the yellow carrots for which it is named, seems to be identical with the long-sought basic material of vitamin A. By a new process, described before the American Chemical Society, it can be produced from carrots in highly concentrated crystalline form, at low cost, and comparatively rapidly. The discoverers of the new process are Drs. Henry N. Holmes and Henry M. Leicester, of Oberlin College.

If you dislike both eating spinach and swallowing pills, you can get your vitamin A or your carotene by taking a "shot in the arm," with a hypodermic needle, just as protection against a lot of infectious diseases is now commonly administered.

The discovery that the injections are possible was announced by Dr. R. G. Turner, of the Detroit College of Medicine and Surgery. He gave such injections to a lot of animals suffering from a lack of vitamin A, and compared their rate of recovery with a set of "controls" given vitamin A with their food in the ordinary manner. The injected animals recovered their health.

Although carrots have thus been shifted from their old job as a "beauty food" to a new one as a health food, chemists still come to the rescue of beauty in distress. Beauty parlors are beginning to use solid carbon dioxide, sold under the trade name of "dry ice," for post-massage rubdowns instead of the old familiar, but somewhat wet and messy, lumps of ice. Solid carbon dioxide evaporates into a dry gas instead of melting into water.

It must, however, be rubbed on lightly and skilfully, warned Dr. D. H. Killefer, of New York, for it is so cold that a too intimate contact will result, paradoxically enough, in a painful burn.

With the oil market in such a condition that prices have to be held up on the points of national guard bayonets, much interest is naturally being attracted by the sessions of the society's division of petroleum chemistry. A part of the discussion was devoted largely to recent advances in our knowledge of the physics and chemistry of things that go into motor fuels; for the stuff we call gasoline is not a single, simple compound like water or wood. And alcohol is a grand mixture of a lot of things—a sort of petroleum cocktail.

Since each of these intimately blended fractions has its own vaporization point, its own ignition point, and its own special properties all down the line, the jobs of carbureter, spark plug and other parts of the long-suffering auto engine will be made much easier by chemical researches that will give automotive engineers information on which to base better design.

CAUSE OF THE CHINA FLOODS

As one of the largest rivers in another great flood brings watery death and destruction to the heart of the world's most thickly populated country, drowning thousands and sending thousands more even to the tops of the city walls for safety, people wonder why China has so many and such disastrous floods.

Irregular and abnormal rainfall descending on arid plains barren of vegetation that would stay the rush of the water to the sea is, in brief, the answer of authorities in geography of the U. S. Department of Commerce. Department of Commerce data show the extreme variability of these rains. Take, for example, the Hupei area at the beginning of the fabled Yangtze gorges. As far back as 1897, rainfall of 10.6 inches is recorded for May. For the same month in 1900 the rainfall was reduced to a meager 1.9 inches. In June of '97 it totaled 2.5 inches, then in July mounted to 16.6 inches, and by August and September fell back to 8 inches or less. July, 1924, holds the heavy precipitation record for that month with 19.8 inches of rain.

The rains in China are always greater in summer than winter and during a normal year at the city of Hankow, the focus of this year's disaster, there is a 40-foot difference in the river's level for these seasons.

Centuries of intense cultivation in China have stripped the land of vegetation. Everything raised must be edible. When the rains fall there is no spongy green carpet to absorb them, and they rush on to swell Yangtze and her tributaries. From out of the gorges, walled high on each side, comes this chief artery of vast China and as soon as the broad alluvial plains are reached the tremendous force of the caged torrent takes effect and the Yangtze spreads out over the country in one muddy, death-bringing blanket.

Attempts have been made by the weary Chinese peasant to build wooden dykes to reenforce the river's natural levees. He pays a tax for that purpose. But something usually happens to the tax and so for seven years, it is estimated, the Yangtze dykes have gone unrepaired. The river deposits material along its edges each time it overflows.

In consequence, the Yangtze has built itself up until in some sections its bed is actually higher than the surrounding plain. Masses of Chinese live in this flood-

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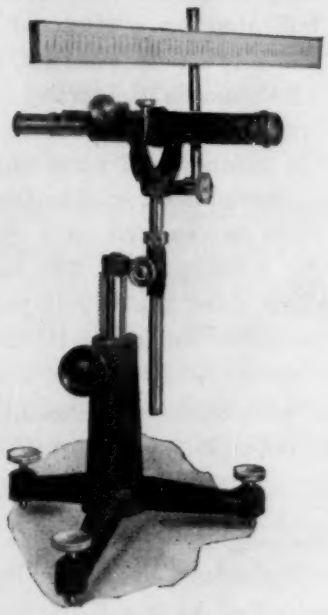

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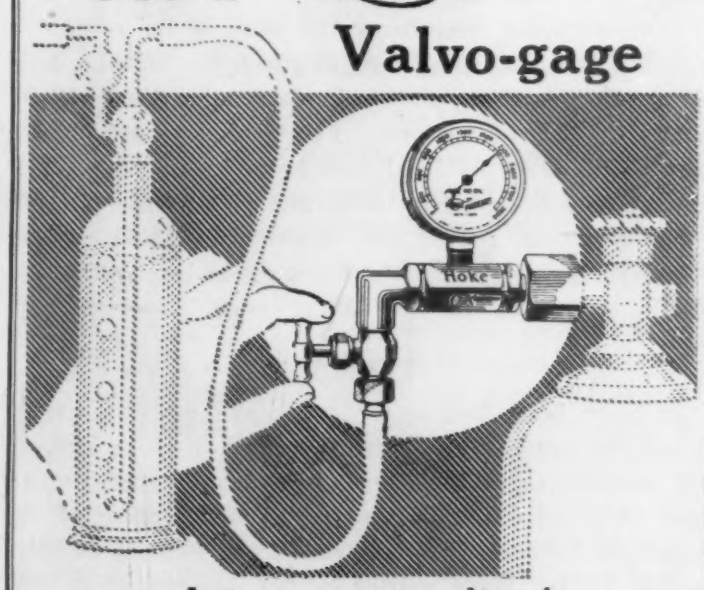

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plain below the river to take advantage of the rich, black soil. And when the monsoon speaks they answer —usually with their lives.

MALARIA IN PALESTINE

MALARIA, which scourges whole Arab village populations in certain marshy districts in Palestine, is being subjected to mass attack by a medical corps with headquarters at the Hebrew University in Jerusalem. The afflicted Arabs, far from being hostile toward their Jewish medical visitors, have been cooperating with them readily in the effort to rid themselves of their perennial ailment.

The first step of the Hebrew University doctors was to find a treatment that could be used effectively in mass treatment of the particular type of malaria prevailing in the district under operation. They found that by combining quinine with plasmochin, one of the newer synthetic quinine derivatives, greater effect on the malaria parasites could be obtained, with less ill effect on the patients. When they had adjusted the dose size by trials with small numbers of individual patients, they were ready for the mass attack.

Two communities of Arabs in marshy regions were selected, one consisting of a group of villages and camps, the other of a single village. Men, women and children, even babies less than two years old, got their daily two doses of quinine plus plasmochin through five days. About 75 per cent. of adults and 85 per cent. of all children received the treatment.

Blood examinations disclosed the presence of malaria germs in 28 per cent. of the total at the beginning of the period, and in only about 7 per cent. at its end—a reduction, therefore, of three fourths of the infection among those treated.

A discouraging feature of the work is the quickness with which the cured patients become re-infected. New cases of malaria appeared in less than three weeks among the treated persons. Furthermore, other studies have shown that the local Anopheles mosquito is often found more than eight miles away from the nearest breeding places. The final clearing of this malaria-afflicted region will, therefore, require a long and hard-fought campaign.

ITEMS

IF your baby has seemed to make no progress in something you have been trying vainly to teach him, do not be discouraged. Some day he may surprise you all of a sudden by just doing it. At the meeting of the American Psychological Association in Toronto on September 10, Dr. Mary Shirley, of the department of psychology of the University of Minnesota, told the psychologists that a child learns many things by leaps and bounds, although it may develop its skill in these things in a more gradual manner. She described a two-years' experiment with twenty Minneapolis babies. Her results were at variance with the generally accepted theories that a child's development is continuous rather than in fits and starts. Dr. Shirley believes it can be both, in fact, but that it is necessary to distinguish between the ability to do something new, and the skill in doing it. Many new behavior items in children seemed to emerge full-fledged, rather than bit by bit.

NEGRO infants develop somewhat more slowly than do white babies, it is indicated by a study of infants of both races made in the city of Tallahassee, Florida, by Myrtle B. McGraw, of Columbia University. This finding contradicts the popular notion that the Negro develops more rapidly in infancy and early childhood but attains his maximum development earlier than does the white child. The study is reported in a current issue of *Genetic Psychology Monographs*. The babies tested were selected at random from the infant population of Tallahassee by the somewhat humorous method of going about from house to house "watching for diapers on the line, or any other known insignia of an infant in the home," and by making "pick-ups" in the local ten-cent store.

CASES of skin poisoning among woodworkers, similar in many respects to the effects of poison ivy or poison oak, have been investigated by the U. S. Public Health Service, which has just reported its findings. The trouble has been due to a hardwood imported from Brazil. In its native land, the wood is known as "embuia"; in America it is given the trade name of Brazilian walnut, though it is not a true walnut but a relative of the laurel. It is highly prized as a material for fine woodwork in Brazil. "Patch tests" given by applying sawdust from the wood to selected skin areas on human volunteers definitely determined its guilt. Not all persons are susceptible, however, and susceptible persons often acquire immunity. During the war, Brazilian walnut was imported to some extent for use in gunstocks, but at that time no trouble was reported.

A NEW tool of importance in the control of agricultural production of the future, may be in the use of x-rays or similar short-wave vibrations, Dr. W. W. Garner, plant physiologist of the U. S. Department of Agriculture, believes. Experimentation in this field is so new that some of the most striking effects have not been followed far enough to reveal their ultimate results. Wild corn plants appear to have been changed from annuals to perennials at Cornell University by treating the seeds with x-rays. And in accordance with experiments in various other places, the evidence seems to be that under suitable conditions, x-rays do bring about a mutation. Dr. Garner may therefore be able to take some sort of hand in plant evolution. The importance this could have on crop production can not be overestimated, he said. However, the future will show to what extent this new tool can be effectively applied in crop improvement. Work along these lines upon plants is being done at the Universities of Missouri and California, while at the University of Texas, the effect of x-rays on the progeny of certain flies has been studied.

HUMAN HEREDITY

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SCIENCE NEWS

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ELECTRON SPEED

A METHOD used by astronomers to determine the velocity of stars has been applied in a slightly modified form to the atom to furnish the first direct evidence that electrons, negatively charged electrical portions of atoms, move about at high speeds in solid bodies. The experiment, conducted at the California Institute of Technology by Dr. Jesse W. M. DuMond, research fellow, and Dr. Harry A. Kirkpatrick, teaching fellow in physics, was the second crucial test of activities of the electrons within the atom. The first test was reported last January.

In explaining the application of the Doppler effect to the experiment, Dr. DuMond declared that if the source of the light or sound is in motion the successive vibrating waves or ripples are crowded together on the forward side of the motion's direction, and spaced farther apart on the rearward side. A similar phenomenon explains the fact that the sound from a train whistle approaching a stationary listener is of higher pitch than the sound of the same whistle when the train is receding from the listener. In the same way, stars approaching an observer emit spectral lines shifted toward the violet end of the spectrum, whereas receding stars emit lines shifted toward the red.

When the electron scatters X-radiation a similar effect occurs. If that part of the radiation which is scattered at a definite angle to the incoming beam is observed with a spectroscope, the spectral line which was in the original radiation is found to be shifted toward longer wave-lengths and the spectral line is found to be broadened. The shift may be regarded analogically as a Doppler effect caused by the velocity of the electron recoiling away from the light under the impact that the light has given it. The increased breadth of the line may be regarded as a composite Doppler effect of the chaotic motion of all the electrons in the myriads of atoms scattering the X-radiation.

Dr. DuMond set the average speed of the invisible electrons which make up solid matter at 1,500 miles per second for the case of carbon. The experiment, which required months of work on the part of Drs. DuMond and Kirkpatrick, not only throws more light upon the internal activities of an atom, but proves two predictions made by Dr. DuMond in 1929: First, that in the spectrum of X-rays scattered by solids of low atomic number, the breadth of the Compton shifted line would be proportional to the sine of one half of the scattering angle; and, second, that it would be proportional to the primary wave-length.

The latest experiment testing the second of the above predictions was conducted with the multi-crystal spectrograph developed at the California Institute of Technology. Measurements were made of characteristic X-rays from molybdenum, silver and tungsten scattered by carbon at an angle of 156 degrees. Spectrum photographs were made of the radiation from each element. Each exposure lasted 1,000 hours.

Dr. DuMond based his predictions two years ago upon the hypothesis that the breadth of the shifted line in the spectrum of scattered X-rays is caused by the movement of electrons in atoms. The fulfilment of the two predictions is therefore confirmatory evidence for the hypothesis on which they were based. Details of the experiment will be published soon in the *Physical Review*. The first prediction was experimentally tested and reported upon last January. The present work refers to tests of the second prediction.

The story of this latest scientific contribution to the world of physics was revealed to a Science Service representative in the DuMond-Kirkpatrick laboratory, where 50,000- and 110,000-volt X-rays were used to find out that electrons really move about.

WEIGHT REDUCTION

RESEARCHES on the internal chemistry of fat folks, reported to the American Chemical Society, at its recent meeting at Buffalo, by Dr. L. H. Newburgh, of the University of Michigan Hospital, have not shown any metabolic abnormality. Dr. Newburgh's investigation included a careful check-up on the intake of energy-producing foods, the exchange of energy within the body and the amount of water absorbed and lost by the stout subjects of his research. He found them normal in all respects. The discomforting conclusion therefore remains that the only way to get too fat is to eat and drink too much.

Another investigation of the chemistry of getting fat was reported by Dr. William E. Anderson, of Yale University. He was particularly concerned with the problem of where the fat comes from, and traced the story of the upbuilding of body fat out of the fragments of sugars and starches. He also hinted at the probability that even proteins, those lean-meat and whole-wheat constituents that are supposed to be the dieter's stand-bys, can be at least to some extent split apart and reassembled into fats.

The smallest visible living things, bacteria, are storers of fat—more notably so, indeed, than humans or hippopotami or whales. Some of them build up a fat content of from 20 to 40 per cent. of their total body weight, according to Professor R. J. Anderson, also of Yale. But bacterial fat is not like the fats of the higher plants and animals. The latter consist of combinations of glycerin with one or more acids. The fatty acids of bacteria are peculiar substances with very large molecules. Injected into normal animals, these bacterial fats stimulate the formation of certain types of cells in excessive amount, leading to the building-up of tubercular tissue. Professor Anderson credited this peculiar physiological activity on the part of bacterial fatty substances to the big-moleculed acids they contain.

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The much-maligned prune has found a defender in Dr. E. F. Kohman, of Washington, D. C. With his associates, W. H. Eddy and Miss Colia Z. Gurin, he made comparative vitamin studies with prunes and grapefruit. They used the prunes both dried and fresh, the grapefruit both fresh and canned. Prunes proved to be much better than grapefruit as sources of the growth-promoting vitamin A. It took 140 times as much grapefruit as it did of prune to induce normal growth in the young white rats that served as test animals. Grapefruit, however, scored over prunes in a test for Vitamin C, which prevents scurvy; and neither of the two fruits proved particularly good as sources for the anti-neuritic vitamin B complex.

OBSERVATIONS ON THE SUN

ORGANIZATION of a world-wide scientific agency for gathering facts on activities in the solar atmosphere is being perfected in Pasadena, California, under the direction of Dr. George E. Hale, director emeritus of the Mount Wilson Observatory. When the organization becomes active throughout the world, the sun will never set on workers who study the activities of sun-spots and prominences. Somewhere on the earth, at every hour of the twenty-four, an astronomer will have his eye upon the solar body.

Twenty-five coelostat telescope and spectrohelioscope stations have been established in widely separated parts of the world for making observations of the sun's actions and reporting to Dr. Hale, who devised the instruments to be used. Dr. Hale has revealed, in an article published by the *Astrophysical Journal,* that 25 instruments have been built or ordered for use at the various stations.

Stations are located at Cambridge, England; Zurich, Switzerland; Florence, Italy; Beirut, Syria; Kodaikanal, South India; Watheroo and Canberra, Australia; Nanking, China; Wellington, New Zealand; Apia, Samoa; Mount Wilson, California; Vermillion, South Dakota; Williams Bay, Wisconsin; Chicago; Columbus; Poughkeepsie, New York; New York City; Cambridge, Massachusetts, and Philadelphia.

"A general scheme of cooperation for the detection of eruptions on the sun's disk in which spectroheliographs may also take part, will be organized in harmony with present cooperative work of the International Astronomical Union," Dr. Hale stated in his paper. "A simple device for transforming a spectrohelioscope into a spectroheliograph has been built and tested at my Solar Observatory," Dr. Hale added. "The design is very inexpensive. The instrument can be employed as a useful auxiliary of standard spectrohelioscopes, especially when it is desired to photograph quickly the forms of rapidly changing eruptive phenomena."

MAGGOT TREATMENT OF WOUNDS

THE "maggot treatment" of bone injuries, in which larvae of blowflies are placed in the wound to clear up the decayed tissue and hasten healing, does not seem to be new. Dr. Hyman I. Goldstein, of Camden, New Jersey, has made a search into medical literature of the past and has found that the beneficial effect of these larvae was suggested by a French surgeon, Baron D. J. Larrey, shortly after the Napoleonic campaign in Egypt.

The baron states that in Syria the wounded were annoyed and often terrified by the appearance of "the larvae of the blue fly" in their injuries. "Nothing short of experience could convince them that these insects, so far from being injurious to their wounds, promoted rather their cicatrization, by cutting short the process of nature and by causing the separation of the cellular eschars which they devoured. These larvae are, indeed, greedy for putrefying substances only, and never touch the parts which are endowed with life."

Even earlier than this, in the sixteenth century, another French surgeon, Ambroise Paré, had observed the frequent presence of fly larvae in wounds, and had some idea of their possible beneficial work. The presence of larvae in wounds is noted in at least one place in the Bible: the terrible death of the Greek ruler Antiochus who persecuted the Jews (II Maccabees 9: 9). But this is recorded as part of the punishment sent upon him for his evil deeds. This ancient instance is not cited by Dr. Goldstein in his article.

The modern use of maggots to clear up wounds, especially bone wounds, dates from observations made in the field during the World War. The well-known Cleveland surgeon, Dr. George W. Crile, called attention in 1917 to the more rapid healing of wounds containing maggots. But it was the late Dr. W. S. Baer, of the Johns Hopkins University, who made the most extensive clinical tests, developed a technique and most vigorously advocated the general adoption of the method.

THE EXPLOSION OF STARS

INHABITANTS of the earth can be glad that the sun is not a star of the B E type, if a theory proposed to the American Astronomical Society by Dr. Dean B. McLaughlin, of the University of Michigan, is correct. Speaking before the society's meeting at the Perkins Observatory of Ohio Wesleyan University, at Delaware, Ohio, Dr. McLaughlin suggested that these stars explode every few years. Thus he explained the peculiar behavior of bright and dark lines in their spectra, obtained when their light is analyzed by the prisms of a spectroscope.

Most stars, like the sun, show a colored spectrum which is crossed by numerous dark lines. But about 1 per cent. of all the stars whose spectra have been observed show bright lines instead. In the B E stars, the bright lines are bisected by dark lines, and the two halves are continually changing in intensity. At times they are of equal brightness; then one may become several times as bright as the other. In explanation of this behavior, Dr. McLaughlin suggested that the star is surrounded by a very extensive atmosphere. The light that causes the bright line comes from the inner part of this atmosphere, but part of it is absorbed in the outer layer, causing the dark line in the center.

"The shifting of the lines and their changes in brightness are interpreted as being due to the gas being blown away from the star by the pressure of the star's radiation, and later falling back to the star again," Dr. McLaughlin explained. "This process takes several months or years for completion, and is repeated indefinitely. The observed shifting of the line represents the actual motions of the gases in the star's atmosphere."

Their behavior is similar to that of the "new" stars, or novae, that suddenly flash out in various parts of the sky, according to Dr. McLaughlin. Such novae are known to be surrounded by a rapidly expanding shell of gas. The difference is that the novae only explode once every million years or so, and then with very great violence, while the B E stars do it every few years or even every few months, in some cases.

Mountains and depressions as high as a mile or as deep as two miles above or below the average surface have been measured on the edge of the moon by H. R. Morgan and Jesse Pawling, of the U. S. Naval Observatory. Mr. Morgan reported that these measurements have been made from 4,000 observations of the time that the moon passed across the meridian. The measurements are made on the edge of the moon and are sometimes too early or too late, depending upon the height of the surface at the point that happens to be on the edge. From these studies it is expected that more accurate observations can be made of the occultations of stars, as the moon passes in front of them. Thus, one of the most difficult problems of astronomy can be solved more accurately.

TEST FOR PREGNANCY

THE fact that the pituitary gland empties an excessive amount of its hormone into the blood within a few days after conception is the basis for a test for pregnancy which has recently been proved accurate by the following investigators: Dr. M. H. Friedman, of the University of Pennsylvania; Dr. H. L. Reinhart and Dr. Ernest Scott, of Ohio State University; Dr. P. F. Schneider, of Northwestern University, and Dr. T. B. Magath and Dr. L. M. Randall, of the Mayo Clinic.

The test, known as the Aschheim-Zondek test because it was devised by Dr. S. Aschheim and Dr. B. Zondek, of Germany, is of extreme medical importance and may be a life-saving measure for the patient. With the overproduction that is characteristic of natural processes having to do with reproduction, more of the pituitary gland's hormone is made at this time than the body needs. All of it is carried about the body in the blood stream and as the blood passes through the kidneys the excess amount of the hormone is filtered out and passes from the body in the secretion of the kidneys. If some of this secretion is injected into non-pregnant female experimental animals, a detectable change in the ovaries of the animals takes place.

There are some diseases which may make women incapable of standing the added strain of pregnancy. If in such a case there is a possibility that conception has taken place, it is of first importance that the fact be known as soon as possible. The Aschheim-Zondek test gives this information earlier than any other method. The test is also valuable for distinguishing at an early stage between pregnancy and tumors or growths which may be dangerous and require immediate removal.

There are a number of other uses of the test which, conscientiously applied, rob the function of reproduction, which occupies so essential a place in our lives, of some of its dangers.

ITEMS

BLUE molds that the housewife knows on bread, oranges, mildewed clothing, jellies and other things also grow in the cracks of "crazed" crockery, the microscope has revealed. Fungi also have tastes for India ink, paste, cork, egg shells, sugar, tulip bulbs, rubber and even paper, Miss Marjory E. Swift reports in the *Journal* of the New York Botanical Garden. Certain similar fungi are the cause of human ailments.

A SACRED spring, timbered and cribbed with cedar logs in ancient times, and at the bottom of which were ten pottery pieces and more than forty prayer-sticks, was found by Dr. Paul S. Martin, leader of the Field Museum Archeological Expedition to the Southwest, at Ackman, Colorado. The prayer-sticks were very similar to those used by Hopi Indians, and pottery types were unlike anything in the neighborhood, belonging apparently to the Chaco style hundreds of miles away in New Mexico. A trench made through a kiva or temple shows walls and floors whose character is very puzzling.

CRANBERRY sauce has vitamin C like citrus fruits, when it is not cooked too long. It loses nothing when cooked two minutes; but if screened or pulped while hot, it loses 75 per cent. of its vitamin value, due to the oxygen of the air which then destroys it. Screening while cold has practically no such effect. Paul D. Isham and Professor Carl R. Fellers, of the Massachusetts Agricultural College, reported these results to the American Chemical Society which met at Buffalo recently.

A NEW electrical musical instrument, using a keyboard and giving musical effects of either piano or organ type, is the invention of Benjamin F. Miessner, radio engineer of Short Hills, New Jersey. It has been demonstrated before several leading pianists, who have expressed satisfaction over its performance. As described by the inventor, the new instrument looks much like a small grand piano. It produces its sounds as a piano does, by striking on strings. But instead of having a sounding-board like a piano, it puts the notes through an electrical translating, amplifying and reproducing apparatus. It may be played as a piano or as an organ, Mr. Miessner states. A wide range of quality may be obtained in either of these, and in addition there are a number of other interesting musical effects, such as tone-swell after key depression. The new instrument gives dynamic control of tone by the weight of the key touch in its organ performance as well as in its piano performance, differing therein from regular organs.

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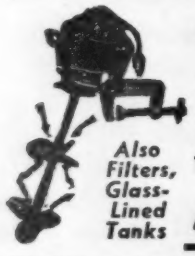

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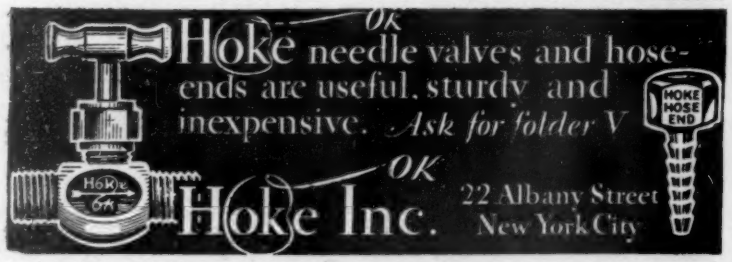

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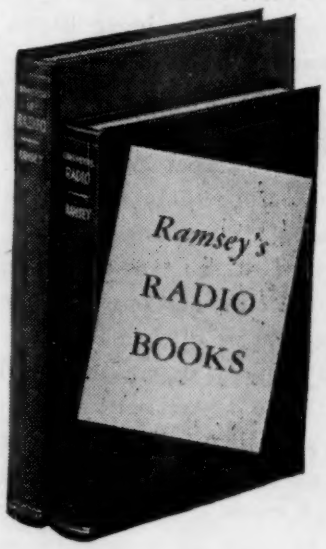

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SCIENCE NEWS

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IMMUNIZATION AGAINST DIPHTHERIA

THE latest methods of preventing diphtheria, the effect of drought on the country's health and what health authorities can do about the current depression were the chief topics discussed before the meeting of the American Public Health Association in Montreal.

"A death from diphtheria must be considered as a result of ignorance or neglect," Dr. W. T. Harrison, of the National Institute of Health, declared at the symposium on toxoid immunization, the latest method of diphtheria prevention. He explained that there are two methods of preventing deaths from this disease—one is early treatment with antitoxin and the other is prevention by immunization with toxoid, the successor to toxin-antitoxin.

"The prevention of diphtheria by active immunization is the greatest thing in public health since Jenner's development of vaccination against smallpox," Dr. Harrison said. He predicted that diphtheria, once the dreaded scourge of childhood, will disappear in a few more years.

Credit for the development of immunization against diphtheria goes to Dr. William H. Park, director of laboratories of the Department of Health of New York City, although toxoid was first introduced by Professor G. Ramon, of the Pasteur Institute in Paris. "Dr. Park has done more than any living man to wipe out diphtheria," according to Dr. Harrison. "He developed toxin-antitoxin and it is his influence on health departments, parents and physicians that has enormously reduced the diphtheria death rates in many American cities."

The diphtheria bacillus produces a poison or toxin which, in massive amounts, causes illness and death. Antitoxin is an antidote to the diphtheria poison and is used to treat cases of the disease. Toxin-antitoxin, on the other hand, is toxin largely neutralized by antitoxin. When it is introduced into the body, the antitoxin gradually splits off, leaving more and more of the toxin. These very small doses of toxin have the effect of raising the body's resistance to the disease or giving it immunity.

When toxin-antitoxin has been frozen for a time it may become inert, or, on the other hand, may become toxic. This uncertainty is entirely absent in toxoid. Toxoid is toxin to which a small amount of the common disinfectant formalin has been added and which is then kept at a temperature of 100 to 102 degrees Fahrenheit for from three to six weeks. During this time it loses all its toxicity but retains its immunizing properties.

Toxoid is entirely non-poisonous and absolutely harmless, Dr. Harrison emphasized. No case of injury has been known to follow its use. Neither is there any danger of serum sickness, as it contains no horse or other serum. It is given in courses of two or three treatments. After the first course, nine tenths of the children become completely immune. Experiments have shown that toxoid is 20 to 30 per cent. more efficient, even when only two doses are given, than is toxin-antitoxin.

Toxoid plus alum gives the best results, Dr. Park and his associate, Dr. May C. Schroeder, reported. Toxoid should be used for preschool children. In a small percentage of older children and adults, toxoid causes a marked local reaction.

EARTH TREMORS BY DYNAMITE

YOSEMITE NATIONAL PARK was the scene recently of several earthquakes, the first artificial tremors of their kind produced for purely scientific purposes. They were engendered not by the slipping of rock layers along a fault line, as in real earthquakes, but by the explosion of charges of dynamite.

The experiment was launched jointly by the Carnegie Institution of Washington, D. C., and the California Institute of Technology, Pasadena, California, under the direction of Dr. John P. Buwalda, chairman of the geology and paleontology division, Dr. Beno Gutenberg, professor of geophysics and seismology at the institute, and Henry Salvatori and assistants, of Dallas, Texas.

Two methods of producing tremors were used. A tunnel, more than 2,300 feet long, was dug by the National Park Service into the cliff east of Bridal Veil Falls. In this tunnel, several hundred feet underground, several hundred pounds of dynamite were exploded twice daily. Vibrations set up by the explosions were registered on instruments many miles distant from the source of the disturbance. Smaller charges were exploded on the surface and the vibrations set up in the solid granite recorded with instruments placed some thousands of feet away.

Dr. Buwalda reported that the "Yosemite Valley is a deep, narrow and vertical-walled chasm, and when vibrations were caused on one side, the surface waves which usually confuse the readings of seismograms were eliminated because they were reflected back when they struck the vertical cliffs on the side of the valley from which they radiated. A network of telephone lines made it possible to send precise time signals from the point of explosion to the recording point."

Three problems were studied. The first was to determine the velocities of earthquake waves in the several different kinds of granite. This was done by determining the exact thousandths of a second required for the vibrations to travel a measured distance through the granite. The second problem was to determine the effect of a vertical-walled canyon or valley on earthquake waves when they travel approximately at right angles or across the valley. Each explosion, Dr. Buwalda said, set up three kinds of tremors, and it was important to know which reached the other side of the canyon and which was eliminated by being reflected back by the canyon wall.

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BABIES AND MILK DRINKING

THE new-born infant can tell the psychologist about what he is able to taste and feel, according to the report of Dr. Kai Jensen, of the Connecticut Agricultural College, to the meeting of the American Psychological Association. The language used by the infants studied by Dr. Jensen was the pressure of their sucks on a nursing bottle as recorded on a complicated apparatus which he designed especially for this purpose. When milk of the correct temperature is in the bottle, the infant will suck and then swallow rhythmically and with equal pressure. But let the temperature be raised or lowered enough and he will suck much less vigorously, with increasing irregularity, until he stops altogether. The temperature acceptable varies greatly with different infants. Some will take it as cold as ten degrees Fahrenheit above freezing point. Some will drink milk as hot as 150 degrees, although the usual temperature for feeding is about 105 degrees. Differences in temperature of less than four degrees are detected by the infants.

To test the sense of taste, salt solutions were given. The weakest solution tasted by the babies was only 225 thousandths of one per cent., and differences as minute as 25 thousandths of a per cent. were noticed. The infants studied were all under twelve days old.

Putting a human baby through a test designed for testing a monkey, giving no directions, but using food for "bait," was one of the steps of a series of experiments described at the meeting by Dr. Louis W. Gellermann, of Yale University. The whole series conducted by Dr. Gellermann and Dr. Walter S. Hunter involved tests of many types of animals, from rats to human adults. They demonstrate a clear difference between the typically human ability of the symbolic type and ability of the ordinary habit-formation type.

The apparatus used in the baby-monkey test consisted of two boxes in which food was placed as rapidly as it was taken out by the infant or animal. Each box had a lock which could be operated by the person giving the test. This he did in such a way that the boxes could be opened only in a particular order, first the right one, second right again, third left, fourth left; continuing thus—twice right, twice left.

Dr. Gellermann found that two separate abilities are involved in the task of learning this pattern without any direction or encouragement other than the urge of hunger. The simple trick of learning to look in the right box first for food is one which the lower animals learn more readily than does the human infant, but the tendency to turn first to the right and then to the left and the ability to discover the pattern of two right and two left are highest in human beings and less in evidence going down the evolutionary scale. Roughly the order for the animals tested seemed to be highest for human adults, next children, then, at about an equal level, human infants and adult chimpanzees, then rhesus monkeys, raccoons and last rats.

MOVING A BUSINESS BUILDING

BUSINESS as usual! Such was the state of affairs in an eight-story telephone switchboard building in Indianapolis, despite the fact that it was moved 52 feet backward and turned a quarter of the way around. While the moving went on, not one of the many telephone wires was idle nor was connection lost with any of the gas, sewer or water mains. By means of a movable bridge, an entrance to the building from the sidewalk was even made possible.

Moving the building was necessary to make room for a new structure. The building's position was changed from one corner of the lot to an adjacent one. Demolition was first considered, only to be abandoned when the loss from such a move was figured at about $1,800,000. The unusual engineering feat was not accomplished without careful preparation. The *Engineering News-Record* describes how tests were carried out with different devices before the plan of moving was decided upon. Parallel steel rollers were finally used as the medium for sliding the building along. A concrete bed six inches thick was laid down as a mat upon which to conduct operations. Timbers and T-rails covered the mat and the moving force was supplied by screw jacks and a donkey engine with cables attached.

When the building was securely braced with steel beams and girders, men went to work with the jacks, and rollers were substituted for the cast-iron pedestals upon which the building rested. The jacks, eighteen of them, succeeded in pushing the building across the block. There it had to be lifted to allow for readjustment of the rollers before the circular move began. With the donkey engine lending a hand, the structure was turned through an angle of 90 degrees so that it finally faced and bordered on streets different from those of its original position. The old pedestals of the building were then replaced.

During the moving no appreciable cracks or breaks appeared in the building and the occupants were said to be unconscious of any motion. The telephone wires were spliced during the operations, while flexible hose connections permitted the steam, water and gas services to continue. Elevators in the building operated everywhere, except in the basement.

MATHEMATICS IN BUSINESS

MORE thorough mathematics, more honest mathematics, is one of the outstanding needs of business at the present time. Without better mathematics than now goes toward the making of statistical economic forecasts, there can be no hope of making such forecasts really mean anything. Thus, in brief, declared Professor Harry C. Carver, of the University of Michigan, in an address before the American Mathematical Association meeting in Minneapolis recently. Professor Carver said, in part:

"It is greatly to be regretted that that phase of business statistics dealing with the analysis and projection of time series rests on an exceedingly unstable foundation. There is absolutely no excuse for this state of affairs. For the most part this work is being done by economists and 'professional forecasters,' who are far more interested in making predictions than they are in estimating the probability that the actual occurrences

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Applications from competent persons should be addressed to Dr. Louis I. Dublin, Chairman of the American National Committee, Metropolitan Life Insurance Company, 1 Madison Avenue, New York, N. Y. The application should include a statement of the candidate's qualifications, a list of his publications, and, if possible, copies of these; also suitable endorsements or testimonials. The applicant should state the problem on which he proposes to work and give some indication of his plan. He may be required to conduct his work at some university or institute approved by the Committee, but the applicant should state whether he has any preference in this respect. The amount of the stipend will depend to some extent on the number of applications submitted and on the particular qualifications of the successful candidates.

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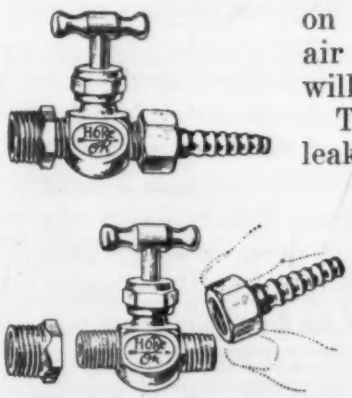

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"But do not infer by these remarks that the mathematical statisticians are at the present time capable of solving all the problems that might reasonably be submitted to them. Nothing could be further from the truth. For instance, the entire theory of sampling will probably require fundamental alterations in order that it may be applied properly to time series, since each sample contains ordered variates with respect to time."

THE HAGERSTOWN METEORITE

THE meteorite fragment that crashed through a garage roof in Hagerstown, Maryland, on the night of September 7 is the world's newest example of a very old class of objects, regarded in antiquity with religious awe and even made the centers of idolatrous worship. The "sacred black stone from heaven" preserved in the Kaaba, or central shrine of the Moslem world at Mecca, is an iron meteorite. Before Mohammed prohibited idolatry among his people, it was the object of actual worship in the primitive, pre-Mohammedan religion of Arabia.

Iron meteorites like the Hagerstown specimen are not as common as stone ones, in the total fall from the skies, but there are more of them in museums, due to the greater likelihood of a stone meteorite's being overlooked as it lies in the open. Nobody knows why some meteorites should consist of pure, or nearly pure, iron, though one theory that is fairly widely accepted holds that they are fragments of the dense inner core of a long-since-destroyed minor planet, drifting through space for ages until they come within the earth's gravitational field. Their light is engendered by friction against the atmosphere as they plunge to the ground.

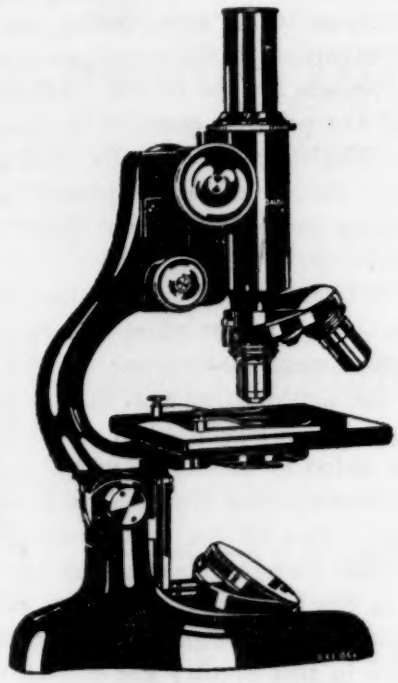
Meteorites may have been the source of the first iron used in tools by mankind. The little iron used by American Indians in pre-Columbian times was all meteoric. Furthermore, the earliest Mesopotamian references to iron have been translated as meaning "stone from heaven," which may be a hint of meteoric origin of at least the first iron known to the inhabitants of Babylonia and Sumeria.

ITEMS

THE general healthfulness of frozen foods was attested to by Professor Carl R. Fellers, of Massachusetts State College, at the meeting of the American Public Health Association which opened in Montreal on September 14. Professor Fellers reported that he found little or no deterioration in quality, appearance or nutritive value of the foods preserved by freezing and cold storage, if the freezing is prompt and rapid and the storage kept at low, constant temperatures. Fruits and vegetables are now frozen, as well as fish, meats, poultry, eggs and oysters. The latter products, however, keep their fresh appearance, flavor and character better than the fruits and vegetables do. The changes in frozen foods are more physical than chemical, Professor Fellers reported. Freezing greatly reduces the number of microorganisms, which may include disease germs present in the foods, and prevents their multiplication. He emphasized that frozen foods should be used promptly and should be eaten while still frozen or within a very few hours after defrosting. More research is needed on the subject, he added.

CHARGES of electricity in 10,000-volt groups are carried up a moving endless silk belt until they have accumulated a potential of 1,500,000 volts on two-foot copper spheres, in a new type of apparatus for exploring the heart of matter which was described before the meeting of the American Physical Society at Schenectady, New York, by Robert J. Van De Graaff, National Research Fellow at Princeton University. While potentials of more than a million volts have been built up in the past by different kinds of generators, the construction of this apparatus is unique. "The generator has the basic advantage of supplying a direct, steady potential," Dr. Van De Graaff said, "thus eliminating certain difficulties inherent in the application of non-steady high potentials. It is simple, inexpensive and portable. An ordinary lamp socket furnishes the only power needed." Two hollow copper spheres, each 24 inches in diameter, mounted on a seven-foot glass rod, accumulate the high tension charges of electricity in each of two identical units, one unit accumulating positive electricity and the other negative. In each unit an endless silk belt runs between a pulley near the ground end of the glass rod and a wheel in the sphere.

TWO mathematicians, independently, and at the same time, announced a new way to solve certain algebra equations, according to their reports to the American Mathematical Association. Professor W. E. Roth, of the University of Wisconsin, and Professor C. C. MacDuffee, of the University of Michigan, explained their methods of solving "matrices" and "matrix" equations. These are important in Einstein's theory of relativity and in the new quantum theory of physics. Professor Roth showed what possible solutions exist under a number of hypotheses, and Professor MacDuffee proved that an earlier theorem of 1860 was not general enough.



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SCIENCE NEWS

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THE BREAKDOWN OF RUBBER

THAT oxygen causes the breakdown of rubber being milled in the course of manufacture was brought out in a report by W. F. Busse, Akron, Ohio, before the annual meeting of the American Chemical Society, at Buffalo. The action of oxygen on the long molecules of rubber breaks them up into shorter ones and causes the rubber to soften. With the use of a photographic plate the presence of peroxides, the breakdown products, was detected.

The process of oxidation takes place rapidly, especially in cold milling. The rollers have the effect of twisting the minute rubber molecules and making them easier victims of attack by the oxygen. As a check on this oxidation theory, milling was performed in the absence of oxygen. Little, if any, breakdown was said to occur. During the morning session, evidence obtained from the use of the x-ray was presented in regard to the nature of rubber. A report by M. F. Acken and W. P. Davey, of Pennsylvania State College, called attention to the fact that normal rubber acts like formless matter toward x-rays. When stretched, however, it causes a bending of x-rays, as would material composed of fibers or thread-like cells.

The investigators found that this reaction to x-rays did not take place as soon as the rubber was stretched, but only after a short time interval in which the so-called fiber structure could be built up. The conclusion was reached that rubber is both a liquid and a solid: fibers with liquid rubber in the spaces between them. This view explained the delay in reaction. Time is required for the liquid to be squeezed out of the spaces, before the molecules of stretched rubber can assume the position of true fibers.

Among the reports presented was that of C. R. Park, of Charleston, West Virginia, and R. B. Maxwell, concerning the rôle of temperature in the vulcanization of rubber. They pointed out that the temperature of the inside of a rubber article being vulcanized is much lower than that of the outside because rubber compounds do not conduct heat easily. Factors were determined to show accurately how temperature affects vulcanization when certain substances take part in the process.

J. W. Ayres, of Easton, Pennsylvania, reported that traces of free ferric sulphate in oxide of iron have been shown by experiment to hasten the aging of rubber. Effects of various compounds which speed up the curing of rubber or delay its deterioration were recounted by J. H. Ingmanson, C. W. Scharf and R. L. Taylor, all of New York City.

THE PREVENTION OF DISEASE

How physicians and medical scientists of the U. S. Public Health Service carry on their warfare against disease has been told in a radio talk broadcast over the network of the Columbia Broadcasting System, under the auspices of *Science Service*. The speaker, Dr. G. W. McCoy, medical director of the U. S. Public Health Service, outlined past victories in the never-ending conflict, but focussed his chief attention on the recent past and the present and on the prospects for the future. After telling of the solution of the pellagra question by research workers of the Public Health Service, he discussed some of the diseases not yet conquered but at present under attack. Notable among these is undulant fever, also known as Malta fever.

"We now know it is tolerably prevalent in the United States," he said, "although a few years ago we knew nothing of it save that occasionally some one was infected from goats in the southwestern part of the United States. We now know that people often are infected by handling diseased swine or cattle. Sausage makers seem to be especially liable to the disease from handling the carcasses of hogs. One of the most controversial points in respect to this disease is as to just how far the infection is due to cow's milk.

"The evidence now available suggests that perhaps half the cases we have in this country are derived from milk. The prevention of milk-borne undulant fever is quite simple: Use only pasteurized or boiled milk and there will be no danger. That this really works in practice is evident by the fact that in communities in which all milk is pasteurized the disease is unknown, while individual cases and small outbreaks occur when milk is not pasteurized. Of course, there are other good reasons for the pasteurization of milk; the risk of undulant fever is to be looked upon as an additional reason.

"The prevention of the cases not due to milk, those due to contact with infected animals or animal products, is unsatisfactory. It is encouraging, however, to know that veterinarians are steadily going forward in research in this important field and that we may look hopefully to the time when the disease in animals can be either abolished or brought under very definite control—and therefore the source of human infections will be eliminated."

Dr. McCoy closed his address with a discussion of the recent discovery that what had formerly been considered one disease, in the eastern United States, is really two: one being typhus fever and the other being either identical with the Rocky Mountain spotted fever or at least indistinguishable from it. The latter disease had hitherto been thought of as confined strictly to the West, and its discovery in the East makes possible, and indeed necessitates, a new plan of campaign against it.

INSURANCE FOR INDUSTRIAL WORKERS

A PLEA for a system of state health insurance was made by Dr. Alice Hamilton, of the Harvard Medical School, world authority on industrial poisons, at the special dinner given in her honor by the American Public Health Association at their meeting at Montreal

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in September. Such a system would be the first step in freeing industrial medicine from its present unfortunate condition of being too closely tied to too many pocketbooks, she said. No rosy picture of the future of industrial medicine can be painted, Dr. Hamilton said. She expressed the wish, although not feeling optimistic enough to make it a prophecy, that the next twenty years would see industrial medicine on the same plane as other medical branches, a subject which could be pursued in as detached and serene a spirit as the study of blood chemistry or the hormones.

Answering the argument that state health insurance is un-American, Dr. Hamilton observed that the American system may work well for the minority of people employed in large, well-managed establishments, but does not for the majority employed in small establishments where proper health safeguards are not taken. There are still many unexplored fields for public health research in the dangerous trades, Dr. Hamilton said, pointing out the need for further research in the large field of dusty trades as a special example. Silicosis from inhaling small particles of hard matter constitutes the hazard there.

Tribute to Dr. Hamilton's accomplishments in industrial hygiene during the past twenty-one years was paid by Professor C.-E. A. Winslow, of Yale University, who said that she holds the position of unquestioned leader as our greatest American expert on the diseases of industrial employes. A movement to give America its own museum of hygiene, which should become a dynamic force in teaching health to the people of the country, was set afoot at the meeting. Specific plans for the museum and its advantages were described in a joint paper by Mr. Homer N. Calver, assistant professor of hygiene at Bellevue and University Medical School of New York University, and Mr. Bertrand Brown, of the Milbank Memorial Fund.

"The present need of America in the battle of life-saving is not for more laboratories but for a more intensive effort which a health museum or chain of museums would represent, making for a better utilization of the products of medical knowledge which our laboratories have already evolved," Mr. Calver said. He described the German hygiene museum at Dresden as a model. Such a museum should not be like an ordinary museum, merely a collection of historical data and objects, but a vital educational institution. Exhibits which the observer is able to operate himself by pushing a button or pulling a lever were suggested among other types which would arouse popular interest. Timely exhibits on subjects like influenza, psittacosis or parrot fever and infantile paralysis were suggested as further aids in attracting as well as in educating visitors.

LIONS OF THE SOUTH AFRICAN NATIONAL PARK

IN South Africa's great Kruger National Park, lions supply the thrills that are given by bears to tourists in the national parks of the United States and Canada. Lion-proof huts are the main features of the rest camps provided for visitors. The rest camps in the Kruger Park are all rather primitive, since most people prefer them so, and there has been considerable agitation against the erection of hotels or other elaborate accommodations. The round huts or "rondavels," made by the natives, are of mud or cement, with cement floors and thatch roofs. In the old-style huts there was a door but no window, an open space being left between the roof and the walls for ventilation. The newer huts have windows, but some people object to these for fear of lions. Instead of one large campfire there is a long, low concrete platform, with holes in the top and front at regular intervals. A fire for cooking is built under each hole by the natives, who are always in attendance.

The Kruger National Park is divided into seven sections, with a ranger in charge of each. With the exception of the Pretorius Kop area, it is open only during the dry season from May 15 to November 15. The Pretorius Kop section may be visited at any time of the year, provided the traveler gets out of the low country before dark and so escapes the possibility of contracting malarial fever.

In a pamphlet distributed to tourists visiting the park, the following interesting "Hints for Our Visitors" are given: "Don't get alarmed if lions stand and stare at your car. They have probably not seen one before, and are naturally overwhelmed with astonishment. They don't mean any harm and in fact are looking at your car and not at you. The lion's nose tells him at once that a car is not good to eat and only smells of petrol, and he has not realized that human beings are inside; if he did he would run away. If you find lions standing or lying in the middle of the road in front of you, it is not necessary to do more than slow down; when you get close they will get up and move to the side out of your way. But don't get within a hundred yards of a lioness with small cubs. She will think you mean to harm them and may take steps to prevent you from doing so. Stop your car until she has got her cubs away, when she will quickly follow them. Don't forget that if you fire and wound a lion or lioness, you are making unnecessary trouble for yourself. The animal, probably merely curious before, will become indignant and may try to get level with you."

After these "Hints" the following plea is put into the mouths of the park lions:

"We, the wild animals of the Kruger National Park, appeal for your sympathy and friendship. You have been our bitter enemies for so long that it takes time to make us understand that a new and happier era has begun for us. Do not betray our trust in you."

CROPS RAISED BY THE INDIANS

THEORISTS who hold that American Indians came from highly civilized lands of the East, or mayhap even from the mythical Lost Atlantis, were told by Dr. E. D. Merrill, director-in-chief of the New York Botanical Garden, in the course of a radio talk delivered under the auspices of *Science Service* and broadcast over the network of the Columbia Broadcasting System, that wherever

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men have gone they have carried with them, as their most valued possession, the seeds of the plants they were used to cultivating; and when the white men found the Indians here, the red-skins, for all their high civilizations in Mexico, Yucatan and Peru, had no Asiatic or other old-world crop plants.

Dr. Merrill said, in part: "It is a curious and incontrovertible fact that previous to 1492 not a single cultivated food plant or a single domesticated animal, except the dog, was common to both hemispheres. Briefly, this means that agriculture was developed independently by primitive man in America strictly on the basis of American plants and animals and that the early American civilizations were developed on the basis of this agriculture. It is only within the past five centuries that there has been a general worldwide dissemination of the basic food plants and domesticated animals. The resemblances between the early American and the Eurasian civilizations are apparently only fortuitous.

"The conclusion that one draws on the basis of biogeographic distribution of plants and animals basic to agriculture is that there were no contacts of importance between Eurasia and America previous to 1492. Had there been in the long period of prehistory only fortuitous and accidental contacts, and these only at long intervals, after the development of agriculture, the first items to be transmitted across the ocean would be seeds and tubers of food-producing plants, that is, those items essential to the maintenance of life, rather than the more advanced arts of architecture, hieroglyphic writings and political, civil and ecclesiastical organization. It is the history of primitive invading or colonizing peoples in such vast areas as Malaysia and Polynesia that they took their food plants with them in their migrations just as at a later date Europeans colonizing America brought their familiar agricultural plants and animals with them and established them in their new homes.

"It is certain that, had any considerable number of these agricultural items of Eurasia been transmitted to America before 1492 and *vice versa*, at least some of them would have persisted in cultivation in their new homes, so that when Europeans actually commenced the exploration of America they would have found somewhere cultivated food plants with which they were familiar at home. What they did find was an agriculture based on a series of plants and animals totally unfamiliar to them and for the most part representing natural groups (genera) different from those of Europe and Asia."

ITEMS

A FEMALE baby chimpanzee, whose development from its very beginning has been known and watched by scientists, has been brought up in the laboratories of comparative psychobiology at Yale University under conditions similar to those of a bottle-fed human infant. Throughout its life it has been carefully measured and watched, and it has been given the same mental and physical tests that are given in the psychological laboratories at Yale to human babies. The results of these tests were described in a report to the American Psychological Association, which met at Toronto recently, made by Carlyle Jacobsen and Joseph Yoshioka, of Yale. The rate of physical development was much greater for the chimpanzee than for the human infants during the first six months of life, but the chimpanzee's growth slowed down during the second half year. The chimpanzee doubled her birth weight in three months, trebled it in six months. At six and one half months she had all her milk teeth except the canines. On tests of motor behavior she showed more rapid development than the human infants up to the eighteen-month tests. She was also superior, although less pronouncedly so, on the tests of adaptive and personal-social behavior up to the twelve-month tests. The order in which the different achievements became possible for her was the same as for the human babies.

AFTER forty years of study and observation, Henry W. Fowler, curator of fish and reptiles at the Philadelphia Academy of Natural Sciences, states that loud talking does not disturb fish, and that the old idea that one must keep still while fishing is without scientific foundation. What really drives the fish off, says Mr. Fowler, is unusual moving shadows upon the surface of the water. Fish have keen eyes, and moving shadows cause them to flee or seek protection in the depths. What really happens is that people who talk and shout move about. Mr. Fowler has also observed that the black plume of smoke issuing from the funnel of an oil-burner will cast shadows that will cause fish to go far below the surface.

A NEW method of solving integral equations was announced by Professor R. E. Langer and Dr. M. L. Hartung, of the University of Wisconsin, at the meeting of the American Mathematical Association in Minneapolis recently. These equations play fundamental rôles in the physical theories of heat, sound, light and electricity. They have been used in the recent revolutionary theories of physics and in the biological theories of heredity. They have played a dominant rôle in checking the "normal frequency law" which is the basis of most statistical theory and practice to-day. Within the last five years it has been shown that a dynamical theory of economics can not be developed without these equations.

A STRANGE degeneracy has overtaken the London sparrow since the World War, according to *Nature*. His tail feathers are breaking off at the roots, sometimes so closely that the quills appear to have been pulled out. But the middle feathers leave stumps a little longer, so that the damaged tail has a rounded appearance. The normal feathered tail, however, is slightly forked. The birds do not seem otherwise degenerate. Whatever the cause, it acts on males and females alike, and swiftly, for one does not see partly broken tails. Before the World War, Londoners remember sparrows appeared with white feathers in their tails. These disappeared again for a few years, but now have come back.

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XXXIII. EDDIES OF THE ATMOSPHERE

SCIENCE NEWS

Science Service, Washington, D. C.

EXPANSION OF THE UNIVERSE

THE universe is actually exploding and the galaxies are scattering apart at a terrific rate, Sir Arthur Eddington, professor of astronomy at Cambridge University, contended before the British Association for the Advancement of Science on September 29. In support of his contention he presented computations based solely on pure mathematical and physical theory, without the use of astronomical data. The rate of recession of nebulae thus obtained is in close accord with Dr. Edwin P. Hubble's Mt. Wilson Observatory figures for the red shift of nebular spectra observed through the hundred-inch telescope.

Professor Hubble said, "Detailed theories of stellar evolution are overshadowed by the fact that the time scale is again in the melting pot. With a rapid-expansion universe, a very long time scale of billions of years, fashionable recently, becomes exceedingly incongruous. We have to accept an age of ten to tenth power or ten billion years for galaxies and presumably also for stars."

Since the age of the earth alone, derived through the radioactive method, is over a billion years this embarrasses astronomers, geologists and biologists. Professor Eddington derived the actual rate of expansion of the universe from the wave equation for the electron, which is the fundamental equation of the modern quantum theory. This equation, adapted to the curvature of space, contains the term: "the square root of the number of electrons in the universe divided by the radius of the universe in a state of equilibrium," which term is the mass of the electron, usually written "$\frac{M C^2}{E^2}$."

Combined with the formulae of the relativity theory, this gives the principal data of the size of the universe. Its original radius was 1,070,000,000 light-years, before it started expanding. Its rate of expansion is 528 kilometers per second per megaparsec, compared with 465 derived from the Hubble astronomical data. It is over a hundred miles per second for each million light-years' distance. "The close accordance of the theory with observation forces acceptance of an alarmingly rapid dispersal of nebulae, with important consequences in limiting the time available for evolution," Professor Eddington concluded.

COSMIC RAYS

IN the depths of space, where atoms are sparse, a cluster of four hydrogen atoms, free from collisions for a long time, will jump over their potential wall and form a nucleus emitting a cosmic ray, Professor Robert Andrews Millikan, of the California Institute of Technology, declared before the British Association for the Advancement of Science. Dr. Millikan's theory is based on the demonstration that atomic changes not found on the earth occur in the nebulae, where atomic collisions are infrequent. Dr. Millikan's new researches during the past summer support the view that cosmic radiation consists of the wirelessed birth-cries of helium, oxygen, silicon and iron, synthesized from hydrogen in interstellar space.

Both Dr. Millikan and Sir Oliver Lodge attacked the second law of thermodynamics. "It is merely a generalization based on observation on earth, that all energy tends to be converted into heat and radiated away, hence lost," said Dr. Millikan. "A final inevitable increase of entropy to a maximum is a bugbear idol to which philosophers need not bow the knee," said Sir Oliver. He also contended that the application of the unvivified laws of physics to the universe assumes there is nothing or no one to wind it up or guide it to some nobler end. Referring to the new quantum theory, he said: "Guiding waves determine the path of a particle of matter. Whether there is any connection of life and mind is still an unanswered question."

THE GERM OF SMALLPOX

DEMONSTRATION that the germ of smallpox is probably a minute spherical body 1/125,000 of an inch, or one fifth of a micron, in diameter, near the lower limit of microscopic visibility, was announced before the meeting of the British Association for the Advancement of Science on September 28 by Professor J. C. G. Ledingham, director of the Lister Institute of London.

This climaxes the medical war against smallpox, which began with Jenner's discovery of vaccination, long before Pasteur founded bacteriology. Although smallpox has been a disease absolutely controlled for decades, incongruously enough its causative organism has been heretofore unknown. For a quarter of a century minute spherical bodies have been found in certain virus diseases, such as smallpox and cowpox, but these have always been ignored. Their agglomerations constitute large inclusions, which are striking features in the body cells and in the pox lesions of patients.

Professor Ledingham made practically pure suspensions of minute bodies from fowl-pox and vaccinal lesions, and found that they reacted specifically with serum from animals that had recovered from attacks of fowl-pox or vaccinia. He also demonstrated the presence of specific agglutinins in the blood serum of a rabbit inoculated with vaccinia. Agglutinins are substances of as yet unknown nature whose presence in the blood causes bacteria and other foreign bodies to gather together in clumps. He believes "that in a fairly large group of virus diseases of both plants and animals such minute elementary bodies are very likely to be found if carefully sought. Such demonstrations would materially assist the study of virus infections whose infective particles are below microscopic vision."

The cultivation of virus vaccinia in a medium containing no living cells was announced by Dr. G. Hardy Eagles, of the Lister Institute. He used a medium composed of extract of rabbit kidney, rabbit blood serum

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THE BUSINESS MANAGER

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The American National Committee of the International Union for the Scientific Investigation of Population Problems has received the offer of $2,500 from the Julius Rosenwald Fund for the purpose of furthering research in this field. The Committee is enabled through this means to offer one or more Fellowships to qualified persons who are engaged in the investigation of population problems.

Applications from competent persons should be addressed to Dr. Louis I. Dublin, Chairman of the American National Committee, Metropolitan Life Insurance Company, 1 Madison Avenue, New York, N. Y. The application should include a statement of the candidate's qualifications, a list of his publications, and, if possible, copies of these; also suitable endorsements or testimonials. The applicant should state the problem on which he proposes to work and give some indication of his plan. He may be required to conduct his work at some university or institute approved by the Committee, but the applicant should state whether he has any preference in this respect. The amount of the stipend will depend to some extent on the number of applications submitted and on the particular qualifications of the successful candidates.

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and salt solution. This first successful attempt to cultivate a virus in a cell-free medium may eventually allow the production of vaccinia in the laboratory instead of in experimental animals. It is also important from a theoretical view-point.

DATING THE ANTIQUITY OF PREHISTORIC MEN

ELEPHANTS' teeth provide reliable means for dating the antiquity of prehistoric men who hunted them and whose remains are buried in the same earth layers with them. Professor Henry Fairfield Osborn, president of the American Museum of Natural History, speaking before the British Association for the Advancement of Science, announced the first application of his new method. He enthroned Eoanthropus, the Dawn Man of Piltdown, as the oldest fossil man known at present, dethroning Pithecanthropus, the Java Man, who becomes a mere survival.

"Man hunted mastodonts and stegodonts or elephants over a long period, estimated geologically at a hundred and a quarter million years," Professor Osborn said. "Elephants have been hunted for ivory, bone and flesh at the close of Pliocene time, when true elephants first appeared, during Pleistocene time, when elephants evolved extraordinarily, and during recent time, when only two species survive."

More or less perfect grinding teeth of fossil elephants have been found in association with human remains. Implements and human fossils have been roughly dated by elephant bones in the past, but now Professor Osborn measures accurately the enamel folds composing the ridge plates of elephant grinders, and assigns each human type a precise elephant or stegodont enamel length. The minimum enamel length of Upper Pliocene elephants is 825 millimeters; the maximum enamel length of Upper Pleistocene elephants is 7,300 to 9,700 millimeters.

Eoanthropus was associated with the ancestral elephant, *Archidiskodon planifrons*, whose enamel length of 825 millimeters proves him to have been of Upper Pliocene date, while Pithecanthropus, associated with Paleoloxodon, of 5,000 millimeters enamel length, proves to have been of Middle Pleistocene time.

AN ARTIFICIAL LAGOON

ICE troubles threatening the enlargement of the water supply of Detroit might be avoided, it was argued, if only a big lagoon existed in the Detroit River. Engineers got together and removed the "if" by building a lagoon. Such a method of insuring an iceless flow of water from the river into the filtration plants of the city, an account in the *Engineering News-Record* explains, is a distinct departure from modern waterworks practice. It required extensive dredging below the river bottom and the building of two rock dikes. Piers of steel and concrete were constructed to define the upstream and downstream sides of the entrance to the lagoon, and provision was made for an outlet to remove refuse.

The effectiveness of the lagoon in eliminating, or greatly reducing, ice troubles lies in the operation of natural phenomena. Needle-like ice, the type which is the chief offender in the Detroit region, will not form under an ice sheet. These ice sheets, in turn, form most quickly over a quiet body of water, such as is provided in a lagoon. Furthermore, given slow enough stream velocities and sufficient time, the needle ice carried in from the river will rise to the surface and stick to the ice sheet before reaching the intake tunnel of the water system.

As adequate data were lacking in regard to "ice" lagoons, dimensions of the one in the Detroit River, situated at the head of Belle Isle, became a question of judgment. The lagoon now is almost half a mile long, with widths varying from 480 feet to 280 feet. It has the shape of a long, narrow oval open at one end, and comprises a water area of 20.7 acres. The lagoon feeds the new intake of the Detroit waterworks, which is estimated to have sufficient capacity to meet demands of the water system for thirty or forty years.

A NEW CLEANSING SUBSTANCE

A NEW and powerful chemical for cleansing purposes is described by Chester L. Baker, industrial chemist of Berkeley, Calif., in a report to the American Chemical Society. The preparation is known to chemists as sodium metasilicate. It is proving especially effective in commercial milk-bottle washing and other operations where a very thorough riddance of grease from glass is necessary. Unlike soap, the new cleanser calls for no vegetable or animal matter in its manufacture. It is very closely related to water-glass, the sirupy product employed commonly in egg preservation. Like water-glass, it requires only soda and sand as its essential chemical sources.

For many years chemists were unable to crystallize the silicate so as to get a standardized white powder which could be readily dissolved as needed. The new washing agent is the outcome of industrial success in crystallizing metasilicate with five parts of chemically combined water. The result is a granulated solid, handy to use, and with peculiarly effective habits.

It is claimed that sodium metasilicate has the highest alkalinity of any washing compound, except common lye. Within limits, cleansing ability is measured by intensity of alkaline chemical activity. Unfortunately, lye is not only too active for use in washing cloth of any kind, but is so powerful that it will attack even hard glass as well as such metals as aluminum, tin and zinc. The metasilicate, while containing a large percentage of available alkali, holds its main strength in reserve, and releases it in just sufficient intensity to attack the most refractory greases without damage to the article washed. In this performance it seems to excel even the very popular and highly approved trisodium phosphate of commerce.

Sodium metasilicate, according to Mr. Baker, has the power of making common soap yield more abundant suds than soap and water alone would produce. Quan-

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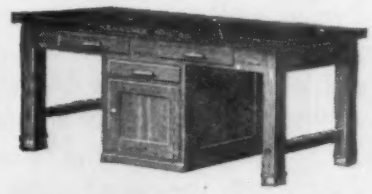

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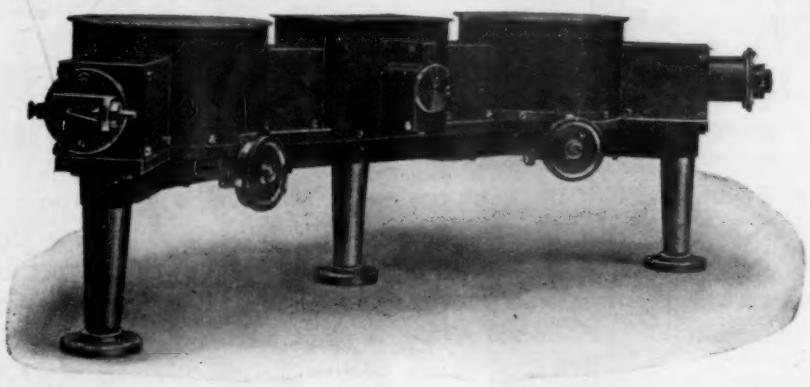

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tity of suds is regarded as a critical index of efficiency. Furthermore, metasilicate solution has an unusually high power of wetting glass, which permits the pushing aside and elimination of grease. At the same time no poisonous material is involved. A considerable use of the preparation in laundries is anticipated.

Although possessing these valuable qualities in solution, sodium metasilicate must be handled with care in the granular form in which it might be retailed. A careful user will see that the material is thoroughly dissolved before use, for the sprinkling of the solid granules upon the wet surface of a painted board would cause serious damage to the finish on account of the formation of highly concentrated alkali solution around the granules.

A NEW AIRPLANE RADIO DEVICE

AVIATORS may receive weather reports without interruption to the radio signals which keep them to their course, now that the U. S. Bureau of Standards has perfected apparatus for the simultaneous transmission of radio beacon direction signals with voice communication.

At present, when a ground station wishes to give pilots information, it must discontinue the beam transmission it uses to direct airplanes. This may mean that aircraft will wander off course and become lost, especially in bad weather when it is necessary to issue information about flying conditions.

For more than a year the Bureau of Standards has experimented with the "visual-range beacon signal" transmitter, which forms the basis of the new beacon system. A pilot has before him a small indicator containing two vibrating reeds. When he is on course the reeds vibrate so rapidly that their ends seem to be two narrow white bands, side by side and of the same height. If the plane gets off course on either side, the amplitude of vibration of the reed increases on the side to which the plane is veering, and therefore the white band on that side becomes wider, while the width of the band on the opposite side decreases. This happens because the reeds are actuated by radio signals sent out on either side of the ground station to which the aviator is flying, and thus he has a visual indication when he wanders too far to either side.

The new apparatus, developed by Mr. F. G. Kear and Mr. G. H. Wintermute, of the bureau, permits the sending of voice by another transmitter on the same frequency. The same aircraft receiver catches both, but a small filter separates the voice from the reed signals and sends the voice to the pilot's headphones. Thus the pilot may listen and guide the plane simultaneously.

All commercial aircraft beacon signals used in the United States to-day are still different, being of the "aural" type. The pilot must steer his plane by ear. Wandering to one side, he catches the code letter "N," or to the other side the code letter "A." When he is in the middle, and on course, he hears both, which then combine to form a long dash. Obviously, while listening to code signals he can not receive voice transmissions, but with the visual range beacon system he steers by sight and may at the same time listen to radio messages.

The first visual range beacons to be established were completed on October 1 along the Los Angeles-Kansas City mid-transcontinental federal airways route. These will not be adapted for the simultaneous voice reception, but it is understood from the Airways Division of the Department of Commerce that the simple receiver filters necessary to make the change-over can be added without difficulty.

ITEMS

THE committee appointed by the Paris Academy of Medicine to investigate the vaccination of newborn babies with living, attenuated tuberculosis germs, has just given a favorable report on the method, which was devised by Professor A. Calmette, of the Pasteur Institute. The committee concluded that there were no proved cases in which the vaccine, known as B.C.G., when given by mouth had changed from its attenuated, weakened form to a virulent disease-causing one. In the great majority of cases there were no ill effects.

THE hope expressed in some quarters that the infantile paralysis outbreak might be ended by the onset of cool weather has not been fulfilled. Although cool weather has come to many parts of the United States, the number of cases of the disease is still high. The total number reported to the U. S. Public Health Service for the week ended September 26 was 1,095. This is slightly lower than the previous week's total, but the decrease is not as marked as it might be. Health authorities are looking with considerable interest to the reports of the next few weeks. States still reporting large numbers of cases for the past week are: New York, 150; New York City, 177; Massachusetts, 105; Connecticut, 81; New Jersey, 93; Pennsylvania, 49; Michigan, 138; Wisconsin, 70; Illinois, 62; Minnesota, 62, and Ohio, 14.

IF a man dies of lead or mercury poisoning, it should not be hard to determine this fact after his death, it appears from a report to the American Pharmaceutical Association, meeting in Miami on July 29, by Dr. E. V. Lynn, of the University of Washington. Dr. Lynn, with his associate, Dr. L. W. Rising, found that the full amount of mercury or lead present in the body at the time of death can be isolated from the body for a protracted period of time thereafter. A great many of the published methods for determiniation of these poisons are faulty, they found. They also reported toxicological studies on cocaine, morphine, phenol and iodine.

INSECTS that produce families of only one sex, instead of the ordinary half-male, half-female ratio, have been studied by Dr. C. W. Metz at the Johns Hopkins University. They belong to the genus *Sciara*, which is a tiny insect related to flies and mosquitoes. Some species of *Sciara*, Dr. Metz found, do have progenies in which both sexes occur, though even here the ratio often tends to be heavily in favor of one sex instead of equally divided between the two. But in other species the offspring of any given female will be either exclusively male or exclusively female.

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SCIENCE NEWS

Science Service, Washington, D. C.

A NEW PAN-AMERICAN DISEASE

THE tropical disease, coastal erysipelas, which causes blindness, can become a Pan-American problem like malaria and yellow fever, in the opinion of Dr. Alfons Dampf, chief entomologist of the Mexican Government, who reported his investigations on the subject in the Chiapas region of southern Mexico to the Pan-American Medical Association.

The disease is caused by a parasite which spends part of its life in bloodsucking insects like buffalo gnats or black flies. Dr. Dampf made a special study of these bloodsucking insects and found that one of them is distributed from Trinidad, West Indies, to northern Mexico and another of them from British Honduras to the state of Vera Cruz and from Guatemala to the state of Oaxaca. As the disease in Mexico is slowly spreading from the interior to the coast, and as the transmitting insects are present in a much greater area, the conclusion is inevitable that onchocerciasis, as the disease is known scientifically, can become distributed over the greater part of Central America, invading perhaps also South America.

The parasite which causes the trouble is a nematode or roundworm of the Filaria family, from one to twenty inches long. It lives coiled up in tumor-like swellings under the skin of human beings. The larvae of this worm, in the form of the so-called microfilaria, swarm up from the cysts or swellings to invade the peripheric lymphatic ducts and are there picked up by bloodsucking insects of the Simulid family (buffalo gnats or black flies). The larvae undergo a transformation in the gnats, after which, the next time the gnat sucks blood, the mature microfilaria are passed from the proboscis of the fly or gnat to another person, Dr. Dampf explained.

As a result of the joint efforts of the commission of the Harvard Medical School under Professor Richard P. Strong, working in Guatemala, and of the various commissions of the Mexican Public Health Department, of which Dr. Rafael Silva is chief, which studied conditions in Chiapas and Oaxaca, the clinical aspects of the disease and the biology of the transmitting insects were learned. These investigations also showed that the vision of man is affected by actual invasion of the eye by the microfilaria. What species of Simulids and how many were concerned in the spread of the disease had still to be shown. Dr. Dampf's study supplied this necessary information.

In view of the danger of spread of the disease, the Mexican Government, through the public health department, has begun an active campaign against the Simulids, the transmitting insects, in Chiapas. The people are being forced to clean the breeding places in the mountain brooks and rivulets, to avoid in this way the imposition of the flies on the submerged vegetation. A special Onchocerciasis Commission, under the leadership of Dr. S. Gonzalez Herrejon, sent a staff of medical officers to the infested places, with the order to operate on every person having tumors and in this way to eliminate the danger of infection.

According to Dr. Dampf's report, the parasite was probably brought from Africa with Negro slaves who escaped from their masters and found a refuge in the interior of Guatemala, where transmitting Simulids are plentiful. In the same way two other disease-producing parasites, *Filaria loa* and *Dracunculus medinensis*, were once brought from Africa to South America.

IDENTIFICATION BY X-RAY

A NEW method of identification which may prove useful to police departments and life insurance companies has been announced by a Washington physician, Dr. Thomas A. Poole. The method makes use of x-ray photographs of the nasal sinuses, those tiny cavities in the skull which have been a source of intense discomfort and pain to many persons in recent years. Examination of over 2,200 pictures of sinuses, collected during the last eight years, have shown that in no two persons are the shapes of these cavities exactly alike, Dr. Poole stated. Furthermore, the bony partitions making the sinus cavities never change. Neither age nor treatment makes any difference in them, so that an x-ray picture taken of them at any time during a person's life will be a lasting and positive means of identification, Dr. Poole declared.

While thousands of x-ray pictures of the sinuses have been taken in nose and throat clinics during recent years, the first suggestion, so far as is known, for their use as a means of identification was made by a keenly observant patient of Dr. Poole's. This patient, Alfred I. Du Pont, has lost his hearing and the use of one eye, but with his remaining eye sees much that the ordinary person might miss, according to Dr. Poole. The latter had taken x-ray pictures of his patient's sinuses at intervals of several months. Mr. Du Pont noticed that the pictures, even after treatment and the lapse of time, showed exactly the same shape and size of sinuses, although the cloudiness of outline had cleared after treatment. He called Dr. Poole's attention to this and suggested that if this were a universal condition, insurance companies would find it a valuable means of identification.

Dr. Poole immediately studied the 2,200 x-ray pictures of sinuses in his own collection and then went to New York where he, together with other physicians, examined thousands of x-ray pictures in the files of the New York Eye and Ear Infirmary. They found no two of the pictures alike. Even twins showed differently shaped sinuses.

Representatives of an insurance company and of the Washington police force have conferred with Dr. Poole and examined his x-ray pictures. They were both very enthusiastic over the new identification method, Dr. Poole said.

X-ray pictures of teeth have occasionally been used to identify persons or dead bodies. X-ray pictures of other bony structures in the body might lend themselves to the same use. The tissues of the body degenerate quickly after death, but bones do not, so that if a rec-

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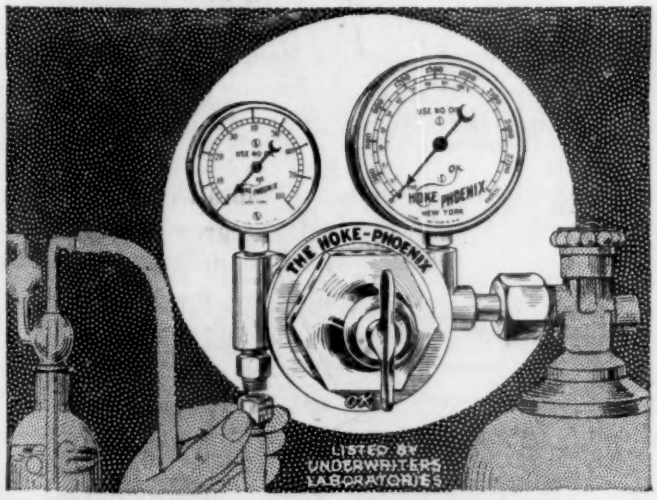

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ord is made of them during life they can be identified later.

THE HAIRLESSNESS OF MAN

MAN did not lose the bulk of his body hair because he took to wearing clothes, or because of any other environmental change adopted by him or forced upon him. The relative hairlessness of humankind is simply the most extreme expression of a general evolutionary trend to reduce the hairy coat in all the highest primates—man and the large apes. Some of the great apes have even fewer hairs per square inch of scalp, and the gorilla at least is often not as hairy-chested as a man. This is among the conclusions reached through a comparative study of hairiness among monkeys, apes and men, conducted by Dr. Adolph H. Schultz, of the Johns Hopkins Medical School, and reported to the journal, *Human Biology*.

Dr. Schultz selected areas of one square centimeter each, on head, chest and back of human beings of three different races and of many species of monkeys and apes. On each of these areas he painstakingly counted the hairs, and then multiplied the number by the total area in square centimeters, to get the total number of hairs.

Several of his results are not what might be expected from *a priori* assumptions. Human beings were found, for example, to have more hairs on their heads than some of the apes. The average number of scalp hairs per square centimeter was 312 for man and 307 for thirteen specimens of the large anthropoid apes. The gibbon, a small Asiatic ape, was much hairier on the head, with 2,035 hairs per square centimeter, and one monkey species, Aotus, had twice as many as that, with 4,083.

Gorillas are less hairy-chested than many men. Two adults had only six and three hairs, respectively, per square centimeter, whereas a man—not a very hairy-chested one at that—had nine. Two chimpanzees were also relatively bare-chested, with counts of 43 and 59; while the gibbon again showed a high count of 499. In regard to the back, man scored an absolute blank, with zero hairs per square centimeter; the anthropoid apes averaged only 276, but the gibbons 1,727. Various lower monkeys were even more hairy-backed.

Scalp hair varies in density among the human races, it appears. Six adult Negroes averaged 297 hairs per square centimeter, and three adult white men had a few more, with an average count of 333. But a Hawaiian showed only 216 per square centimeter, and a Chinese as few as 128.

NEW MATHEMATICAL MACHINE

A NEW machine which can solve the complex mathematical problems arising in the course of scientific research has been made by Professor V. Bush at the Massachusetts Institute of Technology. The "differential analyzer," as Professor Bush calls his mechanical thinker, will do for the advanced branches of science and engineering what the adding machine has done for business accounting methods.

When a physicist or chemist makes a guess or forms a theory about a scientific problem, he can often express it in the form of what he calls a "differential equation." This is a collection of mathematical symbols which has a perfectly definite meaning, but yet the scientist can not test it directly by experiment. The equation must first be "solved." The result of this process is a solution or "integral" which, though also an equation, has the advantage that all the quantities occurring in it can be measured in the laboratory. The obtaining of the solution often requires a high degree of mathematical skill and much patience. Professor Bush's new machine promises to do this difficult and frequently occurring job.

The possibility of using machinery to solve scientific problems was discussed in detail two hundred years ago by the famous German mathematician Leibnitz, who invented the differential calculus. Leibnitz's idea was to relegate to the machine those parts of the process of thought which are inherently mechanical and repetitive. But though he was a great genius and inventor he did not have the accurate machine tools, new alloys, thermionic tubes and photoelectric cells now available to the modern engineer.

The present status of physics and engineering is peculiarly favorable to a development such as Leibnitz imagined. The department of electrical engineering of the Massachusetts Institute of Technology has devoted itself to this problem. The new differential analyzer has already been used to solve problems of electric transmission and has been tested for precision. It consists entirely of mechanical parts. The main problems encountered in its construction have been those of backlash.

INDIVIDUAL VARIATIONS

THE fact that no two individuals, no matter how much they are alike, are absolutely alike in all respects was set forth as the basis of evolutionary progress by Dr. Adolph Schultz, of the Johns Hopkins Medical School, in a radio talk under the auspices of *Science Service*, given on October 9 over the network of the Columbia Broadcasting System.

"It may bluntly be claimed," he said, "that without variations there would be nothing to select from and without selection there could be no progress or at least no lasting change in, or evolution of, our physical make-up. A multitude of selective factors is continually at work among constantly occurring human variations. Some of these factors have lost their efficiency with advance in civilization, but that very advance has introduced new selective processes of sometimes very doubtful benefit to the human race. It is most essential that all these selections be carefully investigated so that we shall become able to place them under our control."

Variations are so ingrained in all living things that even the most intimate similarities prove on close examination to be differences still. Identical twins are not identical. They may be as like as two peas; but no two peas are alike when you look at them critically. Not even the individual is like himself; one of your arms is longer than the other, one of your shoulders higher, one

of your ears a little bigger. Absolute symmetry of parts does not exist anywhere in nature. Individual variations are as marked among animals as they are among men. All monkeys look alike to the casual observer, but Dr. Schultz has not found them so. He said:

"Among several hundred monkeys of one species, collected in the uniform environment surrounding one camp in the forest of Nicaragua, I found specimens with pug noses and those with straight profiles, some with large ears and others with small ones. In short, they differed from one another as widely as would an equal number of human city-dwellers and this in spite of the fact that these monkeys all had the same occupation, the same diet, the same climatic conditions, etc., and this during thousands of generations."

SHIP FUMIGATION

THE latest methods of fumigating loaded ships, as used at the New York quarantine station of the U. S. Public Health Service, have just been observed by a group of experts appointed by a special commission of the Health Section of the League of Nations. These experts reported they were highly pleased with the methods, which were demonstrated by Surgeon Charles L. Williams, of the U. S. Public Health Service. They will present a report of their investigations to the League of Nations next month.

Surgeon-General Hugh S. Cumming, of the U. S. Public Health Service, is chairman of the committee of experts. Other members are: Dr. R. C. Stock and Dr. C. W. Monier-Williams, of the British Ministry of Health, London; Dr. Adolfo Vila, of Cadiz, Spain; Dr. M. F. DeBruyne, of Rotterdam, Holland; Dr. Charles Vigne, of Havre, France; Dr. William Dryer, of Bremerhaven, Germany, and Dr. Charles L. Williams, of the U. S. Public Health Service.

Fumigation of ships is carried on to destroy rats and vermin that might carry disease and thus to protect seaports and nations generally from importation of disease. Fumigation of loaded ships presents a difficult problem which the U. S. Public Health Service seems to have met satisfactorily.

The method, as described by Dr. Williams, consists in spraying liquid hydrocyanic acid under a pressure of 75 to 100 pounds. The airjet sprayer used is an adaptation of the ordinary oxyacetylene blowpipe, the hydrocyanic acid being connected with the acetylene side and the compressed air to the oxygen side. This method was most successful in forcing the fumigating material into all parts of the ship. Other methods of fumigation will still be satisfactory on the ordinary ship which does not present special problems such as heavy rat infestation or inaccessibility due to large cargoes, and at the smaller quarantine stations which are not equipped to handle the more complicated new method.

ITEMS

RADIO reception is getting better, and it will continue to improve during the winter months, attaining conditions which have not been duplicated since the great improvement in radio receivers and the advent of the high-powered transmitting stations of recent years. This is the observation and prediction of Dr. Harlan T. Stetson, director of Perkins Observatory of Ohio Wesleyan University, at Delaware, Ohio, who has made careful studies of the relation between sun-spots and radio reception. Dr. Stetson says that during the past six months, from March to September, radio reception improved 400 per cent. During the same period sun-spot activity became less, the sun-spot index for September being only half its March value.

NEW evidence that liquid water molecules form in clumps of two or more has been presented by Professor Joseph W. Ellis, of the University of California at Los Angeles. The new evidence comes from the way in which infra-red or heat rays are absorbed by water. Certain new bands or dark patches observed in the infra-red spectrum favor the theory that the simple chemical units of two hydrogen and one oxygen molecules are probably linked in groups or even form a lattice-like structure. This theory has not been in favor with chemists recently. However, some phenomena observed during the formation of ice lend considerable weight to the idea.

COLORED flower-saps, extracted from the petals of a number of species, are being used to test the degree of acidity or alkalinity of chemical solutions, by Dr. E. P. Smith, a British botanist. It has long been known, in a casual way, that some blue flowers, dropped into a weak acid solution, will turn pink, but hitherto an exact measurement of their value as litmus-like indicators has not been undertaken. Dr. Smith has determined the color-values of a number of saps, ranging through red, blue, violet and purple, in the presence of a wide range of acidities and alkalinities. Among the flowers he has used are species of anemone, cineraria, hibiscus, primrose, tulip and morning-glory.

TURTLE by the ton is being handled by the Missouri Game and Fish Department in its project to eradicate undesirable fish and other aquatic animals from Lake Taneycomo. In the short space of two months more than 4,000 turtles, aggregating nearly eight tons in weight, were removed with nets from the lake, and at the same time a few bass, bluegill, carp and catfish were taken. All the game fish were returned to the lake, while some of the carp supplied fresh food for needy families in the community.

A DECREASE in infantile paralysis all over the country appeared in the reports of state health officers to the U. S. Public Health Service for the week of October 3, the last for which figures are available. The total was 955, which is 140 less than the previous week's total. States still reporting large numbers of cases were Massachusetts, 142; New York, 135; New York City, 140, and Michigan, 112. These figures are all lower than those reported last week by the same states, however.

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SCIENCE NEWS

Science Service, Washington, D. C.

STEREOSCOPIC X-RAY DEVICE

A STEREOFLUOROSCOPE x-ray instrument that shows the inner workings of the human body as though it were a moving picture has been perfected at the California Institute of Technology and will be installed in the Henry Phipps Institute at Philadelphia, where practical medical experiments are to be conducted. Several months ago a rough experimental model was completed and caused great interest when introduced to the medical world. When it proved a success funds were secured from the Rockefeller Foundation for construction of a more elaborate instrument designed for use in hospitals.

The instrument was developed by Dr. Jesse W. M. DuMond, research fellow in physics, Dr. Archer Hoyt, teaching fellow in physics, and Clarence Brandmyer, at the California Institute of Technology. Dr. Hoyt has left Pasadena to become an instructor at Cornell. These men worked out the details of the instrument, which was built during the last three months at the institute.

An announcement inviting the public to view the instrument reveals that the instrument consists of two x-ray tubes connected to a single transformer so that they are alternately caused to emit x-rays by alternations of a fifty-cycle alternating current. The alternate x-ray impulses emitted by the tubes project alternate shadow pictures of the object to be viewed on a single fluorescent screen. Since tubes are spaced apart at approximately the same distance as the distance between the two eyes, the shadow pictures projected on the screen differ slightly in the point of view in the same way that two images in the right and left eye differ respectively from each other when the eyes view any object in three dimensions.

To give the impression of a three-dimensional stereoscopic plastic relief, it is only necessary to arrange that each eye shall see one and only one of the two images formed by the two tubes. This is accomplished by means of a special rotating shutter placed before the eyes and driven by a synchronized motor in such a way that the right eye looks at the time the right-hand x-ray tube is emitting rays and the left eye looks at the time the left tube is emitting.

By observing certain geometrical relationships between parts it is possible to have the stereoscopic image appear in space in front of the screen as an exact scale reproduction. Calipers are provided that can be introduced into the image and brought into apparent contact with any two parts of the image whose separation or size is desired. Scale measurements on the inside of the human body can be made in height, breadth or depth, or, in fact, any direction whatever.

AMERICAN HOSPITAL STANDARDS

THE financial depression has not affected hospital standards, it appears from the report of Dr. Franklin A. Martin, director-general of the American College of Surgeons, at the opening session of the twenty-first annual clinical congress of the college in New York City. More hospitals than ever before have this year met the high standards for personnel, management and equipment required by the college for a place on its list of approved institutions for the care of the sick. Of 3,319 hospitals surveyed in the United States and Canada, 2,158 won the official approval of the college. Sixty-six cancer clinics in general hospitals and medical services in eighty industries have also been approved by the American College of Surgeons, it was announced.

"The economic crisis seems to have acted as a challenge to these hospitals to keep their standards higher than ever in order to give safe care for the many persons needing medical aid in times of financial stress," said Dr. Martin. "The increase in the number of sick has placed a heavy burden upon approved hospitals, but they have borne it splendidly. This, I feel, has been due in part to the fact that the minimum standards which they must meet are based on sound economic principles."

The public must be educated to an appreciation of the great achievements of modern medicine, so that it may discriminate between reputable physicians and irregular practitioners of medicine, according to Dr. Allen B. Kanavel, of Chicago, president of the college and professor of surgery at Northwestern University Medical School. At present the public attributes any attack by physicians upon other forms of medical practice to jealousy and factional discord. "There are so many chiropracters, naturopaths, cancer quacks, faith healers, osteopaths, electropaths, Chinese herbalists, bonesetters, electric belt adherents, buckeye specialists, to say nothing of Lydia Pinkhams and devotees of patent medicine, that the trained physician must almost wear spurs on his elbows," declared Dr. Kanavel.

"Legal restriction can go no faster than public education," he said in discussing the situation. "We have had an example of this in our recent attempt to control by law the sale of intoxicants. We must therefore disabuse our minds of the vain hope of quick results and depend upon general education of the people." He urged hospitals to give intensive study to the possibility of reducing at least part of their charges, in order to meet the present public resentment at these items of medical care. The public's criticism is apt to be unjust, he admitted, because the public forgets the increased cost of service in all phases of economic life and is ignorant of such necessary adjuncts to hospital service as chemical and x-ray laboratories and social service and free beds. He also suggested that the private patient be freed from the overcharge incidental to the care of free patients and that the latter be supported exclusively by endowments.

Hospital physicians need to give more thought to the training of the internes, Dr. C. Jeff Miller, of New Orleans, retiring president of the college, urged. First-year internes should not be permitted to do surgery, independently, even under the strictest supervision, Dr.

Miller stated, but should be taught "not only the mechanical and material side of medical practice but the ethics of their calling and the ideals of their art. . . . It would profit us to remember that the internes we are training to-day are the physicians and surgeons of tomorrow. We can not take too deeply to heart the heavy responsibility that lies upon us for the type of practitioner they are going to become," he concluded.

RADIOACTIVE WATERS

WARNING against the use of radioactive waters and radium emanators, frequently promoted for the cure of a great variety of diseases and ailments, was contained in a report by Dr. Harrison S. Martland, medical examiner of Essex County, and physician at the City Hospital, Newark, N. J., to the *American Journal of Cancer Research* made public recently.

From long study of the effects of radium poisoning in the luminous watch dial painters, Dr. Martland has concluded that it is dangerous to increase the normal radioactivity of the human body, on the strong presumption that increased amounts of radioactivity over a number of years may produce cancer. "The drinking over long periods of time of radioactive waters containing radon may allow a small amount of active, long-lived deposit to enter the body, part of which may finally be deposited in the bones and other organs as more or less insoluble salts," he stated. Such deposits of insoluble salts of radium and other radioactive substances were responsible for the development of fatal cancer (sarcoma) in the watch dial painters, Dr. Martland showed in the report.

Some of the radioactive waters for sale, when taken according to directions of the promoters, would mean that there would be swallowed each day an amount of radioactive substance equal to that taken by some of the dial painters, he found. These substances are in soluble form in the water, but they are changed in the blood to the more insoluble carbonates, phosphates and even sulphates of radium and mesothorium and eventually reach the bones. Once deposited there in insoluble form, there is no way known now to eliminate them from the body or to protect it from their fatal bombardment of alpha particles, with the exception, possibly, of methods of treatment similar to those used in the treatment of chronic lead poisoning. Radium emanators and the waters of natural radioactive springs were objected to by Dr. Martland on the same grounds.

SCHOOL VENTILATING SYSTEMS

MORE than $2,500,000 is being wasted annually by many cities throughout the country on unnecessary and even hazardous ventilating systems for schools, Dr. C.-E. A. Winslow, professor of public health at Yale University, estimated in a report published on October 19 by the New York Commission on Ventilation, of which Dr. Winslow is chairman.

Twenty states in the Union still have laws or other regulations concerning ventilating devices which are based on disproved or antiquated theories, the commission found, although scientific knowledge concerning the proper ventilation of buildings has been in the possession of architects, hygienists and engineers for more than twenty-five years. For example, these twenty states require that there be an air supply of thirty cubic feet per minute per person, a condition which can only be obtained by mechanical ventilation involving the use of fans. This system is not only costly, but may in some circumstances be a menace to health, the commission reported, since it tends to produce drafts and overheating.

The evidence gathered during the investigation all showed unmistakably that the window-gravity method of ventilation, in the absence of specific unfavorable conditions, is generally more satisfactory than the fan system because it maintains more uniform temperature, humidity and air movement. Among other things the commission recommended maintenance of a room temperature of 65 degrees Fahrenheit in corridors, gymnasiums and shops; of 75 degrees in swimming pools and adjacent dressing rooms; and of 68 degrees in all other occupied rooms.

"The avoidance of overheating is of primary importance for the promotion of comfort and efficiency and the maintenance of resistance against disease," the report stated. "All classrooms shall have at least fifteen square feet of floor space and two hundred cubic feet of air space per pupil," was another recommendation for a model ventilation law. An accurate thermometer for each class, study, assembly and physical recreation room was a third recommendation.

"Existing ventilation regulations should be replaced by laws outlining the major objectives of schoolroom ventilation and delegating to some small expert official body the power to determine whether specific plans for school ventilation are adequate to attain these objectives," the report concluded.

ARTHRITIS

"MARKED improvement or even cure" in three fourths of all cases of arthritis, commonly called rheumatism, may be expected from modern methods of diagnosis and treatment of this ancient and wide-spread disease, Dr. Ralph Pemberton, associate professor of medicine at the Graduate School of the University of Pennsylvania, declared in a radio talk over station WCBS in New York City. Dr. Pemberton's talk was a part of the clinical congress of the American College of Surgeons.

"The word arthritis means inflammation of a joint and forms part of the larger topic of rheumatism in general," Dr. Pemberton explained. "Rheumatism can be divided into acute rheumatic fever and various subacute or chronic forms, of which arthritis is the chief example. Acute rheumatic fever chiefly affects young people and may damage the heart. It is a serious disease if not cared for, and requires long rest in bed, but it is not a great sociologic burden. Arthritis and chronic rheumatism, however, in their several forms constitute perhaps the greatest single economic burden which society bears and have been the cause of untold misery," he said.

Among the causes of arthritis Dr. Pemberton listed hereditary tendencies, poor bodily make-up, over-fatigue, focal infections, faulty food habits and improper func-

tion of the digestive system. Women are affected about twice as often as men. "Treatment of arthritis, to be successful, must begin with a correct diagnosis of the type of the disease and must include an open-minded outlook on the many factors which produce it," Dr. Pemberton stated. "It is too frequently the custom to-day merely to give aspirin to the person affected and to treat the matter lightly. This is wholly wrong."

Dr. Pemberton stressed the need of rest in arthritis, saying that it is almost essential to any and all treatment. By this he meant complete bodily rest for several hours each day, often including confinement to bed. "Every arthritic should realize that the statistical possibilities of benefit are definitely in his favor under the best conditions of modern treatment and neither he nor his physician should cease until the maximum benefit is obtained. There are few chronic diseases for which more can be done," he concluded.

ITEMS

THE need for seeking early treatment in cancer of the stomach was stressed by Dr. Donald C. Balfour, of the Mayo Clinic, Rochester, Minnesota, at the recent meeting of the American College of Surgeons, in New York. In spite of the fact that this disease is curable when seen in the early stages, not even an attempt at cure can be made in three fourths of the cases when the patients are first seen, Dr. Balfour said. He reported a study of the case histories of 128 patients on whom an operation for this condition was done and who lived for ten years or more following the operation. The death rate in this operation when performed under good conditions is about 10 per cent., which is not high, considering that otherwise an early and distressing death is inevitable, Dr. Balfour pointed out.

THE director may shout and the camera grind loudly, but only the desired music and the voices of the actors will be heard in the talking movies being filmed, if the noisy director and camera are in the plane of zero reception of a new type of microphone that has been developed recently. The pressure type of microphone now in use in recording sound pictures has practically no sense of sound direction, picking up all sounds promiscuously. The result is that objectionable noises, such as those produced by the grinding of the camera, often cause great worry and inconvenience in making a talking film. But the new instrument, known as a ribbon microphone, has a marked directional characteristic.

"THE American College of Surgeons regards the education of the public as to scientific medicine an official duty and your personal obligation," Dr. Allen B. Kanavel, of Chicago, president of the college, told the newly initiated fellows of the college at its closing session in New York. "Charlatanism is not a modern evil," he said, in reviewing activities of the college to elevate the standards of surgical practice. "In the seventeenth century quacks pretended to remove stones from the head to cure insanity."

WORKING in an observatory in Cape Town, an astronomer has just learned the latest news concerning an explosion that occurred nearly 2,200 years ago, when ancient Carthage was at its height. The astronomer is Dr. H. Spencer Jones, His Majesty's astronomer at the Cape, and the explosion was in a star in the constellation of Pictor, the painter, which can not be seen from northern latitudes. So distant is the star, according to Dr. Jones' calculations, that its light takes about 2,173 years to reach the earth, so that the first word of this ancient explosion arrived in 1925, when a bright star was suddenly noticed where a faint one had been seen before.

BIRDS broke into the talkies, recently, in Detroit, Michigan, when Arthur R. Brand, of Cornell University, presented before the meeting of the American Ornithologists' Union a film, "illustrated" with sound, of a number of singing birds which he had successfully stalked with motion picture camera and sound recorder. This was a climax of a great display of bird movies, showing a total of nearly six miles of film before the largest gathering of American and Canadian ornithologists that has ever been assembled in one place.

THE sow-and-reap method so common to agriculture is on trial in the oyster industry. A company operating at Padilla Bay on Puget Sound will plant seed oysters from Japan about the first of each year and harvest them the following fall. Fifty million oysters are now growing in the Padilla beds and will be ready for cocktails before long. Care will be taken not to let the oysters reach the gigantic, "beefsteak" size they would if allowed to attain their full growth.

AN apparatus that measures the temperatures preferred by cockroaches shows that the drier they are the cooler they like to be. In moist air they are content to be a little warmer. Cockroaches lose about 9 per cent. of their body weight a day, when they are in dry air at 86 degrees Fahrenheit. In four days they die. D. L. Gunn, zoologist at the University of Birmingham, has made these experiments. A German scientist found that beetles react in a similar way.

HARDENED metals become still harder if they are put in a rotating magnetic field. In a report to the American Society for Steel Treatment, Mr. C. H. Desch explained that the results obtained from this new method are of practical value. Not only are metals like iron and steel affected in this way, Mr. Desch pointed out, but those such as brass and duralumin as well. In an experiment with duralumin the degree of hardness normally attained in thirty-four hours was reached by the magnetic method in twelve hours. Working tools may be so treated, too, no matter how complicated their form. The effect of a magnetic field in hardening metals was discovered by the English metallurgist, E. G. Herbert.

WALKER PRIZES IN NATURAL HISTORY

Two prizes, founded by the late Dr. William Johnson Walker, are annually offered by the BOSTON SOCIETY OF NATURAL HISTORY for the best memoirs written in the English language, on subjects proposed by the Board of Trustees.

For the best memoir presented a prize of sixty dollars may be awarded; if, however, the memoir be one of marked merit, the amount may be increased to one hundred dollars, at the discretion of the Walker Prize Committee.

For the next best memoir a prize not exceeding fifty dollars may be awarded.

Prizes will not be awarded unless the memoirs presented are of adequate merit.

The competition for these prizes is not restricted, but is open to all. It is nevertheless the tradition of the Society that the founder of these prizes intended them more in the nature of encouragement to younger naturalists than as rewards for the work of mature investigators.

Attention is especially called to the following points:

1. In all cases the memoirs are to be based on a considerable body of original and unpublished work, accompanied by a general review of the literature of the subject.

2. Anything in the memoir which shall furnish proof of the identity of the author, shall be considered as debarring the memoir from competition.

3. Although the awards will be based on their intrinsic merits, preference may be given to memoirs bearing evidence of having been prepared with special reference to competition for these prizes.

4. Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed with a motto corresponding to one borne by the manuscript, and must be in the hands of the Secretary on or before March 1 of the year for which the prize is offered.

5. The Society assumes no responsibility for publication of manuscripts submitted, and publication should not be made before the Annual Meeting of the Society in May.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SECOND LAW OF THERMODYNAMICS

A NEW theory which may explain why the physical world sometimes behaves unexpectedly has been outlined by Professor G. N. Lewis, of the University of California. The new system is called generalized thermodynamics.

The science of thermodynamics, which has been so powerful in explaining large classes of physical phenomena, is inadequate in that it does not include those fluctuations from the condition of balance that actually occur in the world. Professor Lewis, who is well known as one of the most important thinkers on the fundamentals of science, has attempted to bring the known facts about fluctuations and the general laws of thermodynamics into one scheme. Though it is impossible at present to say what value the new theory has, scientists will study with interest this latest contribution to a basic question. Thermodynamics is the science of the broad relations between physical quantities which does not require any special knowledge as to how substances are made up of atoms. It is fundamental in the scientific discussion of engines and motors, for instance.

The second law of thermodynamics, which tells us that the world is becoming more and more mixed up as time goes on, has been given a new formulation by Professor Lewis in his paper. He claims that his is the first really valid statement of the law that will stand examination in the light of the unexpected happenings which sometimes appear. Those unforeseen fluctuations, though regular to a certain degree, are nevertheless at variance with the regularities of thermodynamics.

Thermodynamics tells us that a system of physical bodies isolated from others will steadily change towards a unique condition of balance or equilibrium. In point of fact the final condition is one in which the balance oscillates between states near the true balance. These fluctuations from the theoretical balance are such that ordinary thermodynamics can not inform us of them. Some time ago Professor Albert Einstein combined the first approximation given by thermodynamics with the Boltzman probability theorem and thus obtained a first solution of the problem.

Professor Lewis has now carried the question a step further. He expresses the crucial point of his new discovery as follows: "All the laws of thermodynamics and of fluctuations may be shown to follow from a single cardinal postulate, which is essentially the following: If a given amount of some quantity such as energy or any form of matter is allowed to distribute itself between two systems, so that by one observation we find a certain fraction of the total amount in the first system, and again, after a long time by a second observation we find a slightly different fraction, and so on until the statistical rules governing the observations have been ascertained—then these rules are independent of the mode of communication between the two systems."

THE TUBERCULIN TEST

IOWA farmers who have carried their objection to tuberculin testing of their cattle almost to the point of armed rebellion have permitted themselves to become excited over a misunderstanding, and to a certain extent over deliberately spread misinformation. Such is the opinion expressed by scientists at the U. S. Department of Agriculture at Washington.

Tuberculin never does a healthy cow the slightest harm, declared Dr. M. Dorset, chief of the biochemic division of the Bureau of Animal Industry, in an interview given to a representative of Science Service. It does not even hurt a tuberculous animal, but merely shows that she has the disease and ought to be slaughtered in the interests of community health. Claims to the contrary, he indicated, are the results either of lack of information as to its real nature or of hostile propaganda. Tuberculin is essentially the clear, sterilized fluid derived from broth cultures of the tuberculosis bacillus, he said. It is entirely free of tubercle bacilli and of harmful bacteria of all kinds.

The test is administered in a way that will cause no discomfort to healthy animals and only a minimum to sick ones. A single drop of the fluid is injected into the thin skin on the under side of the tail. After from forty-eight to seventy-two hours this point of injection is examined. If the animal is healthy, no trace of the injection will then be found. If there is a small, inflamed lump, it is judged due to the reaction of the tuberculin upon the animal's tissues which have been made hypersensitive by the presence, somewhere in the body, of tubercular infection.

The fluid used by the testing officers is essentially the same as that used in determining whether or not a human patient has tuberculosis, Dr. Dorset said. In fact, tuberculin was originally made in the hope that it would be a cure for tuberculosis, and when it was found that it could not do that it was also learned that it could be made very useful as a sensitive agent in diagnosis.

The work of tuberculin testing of cattle all over the country is carried on cooperatively by the U. S. Department of Agriculture and the various state governments. Field men representing both the department and the states work together, and both federal and state funds are used in reimbursing farmers for cattle which it is found necessary to have killed. There have been some lawsuits against the official bodies concerned by disbelievers in the efficacy of tuberculin testing, but these have all been decided in favor of the Department of Agriculture and of the states. Hitherto no resistance by force has been offered, and department officers feel sure that the work of testing will be carried on after the present flare-up in the Mid-west has been peacefully settled.

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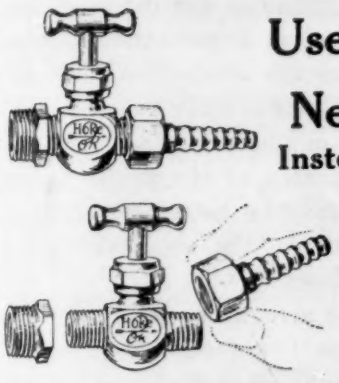

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THE STUDY OF IDENTICAL TWINS

WANTED: Identical twins who have been reared apart, for purposes of scientific investigation.

A great service would be rendered to science by any one who could give information about such twins, Professor H. H. Newman, of the University of Chicago, stated in a radio talk presented recently under the auspices of Science Service over the Columbia Broadcasting System. "Identical twins are those twins that look so much alike that they are often mistaken for each other," Professor Newman explained. "When they are babies one sometimes gets two baths and the other none, and when they are grown up even their best friends call one by the name of the other." Such twins have identical heredities, and consequently when reared apart make excellent material for study of the old problem of whether nature or nurture has more effect on the individual.

"Identical twins are of peculiar scientific interest, for they are the product of the symmetrical division of a single embryo, derived from a single fertilized egg," according to Professor Newman. "Such a fertilized egg typically develops into a single individual with a body composed of two nearly symmetrical halves. A pair of identical twins starts out to become an ordinary single individual with right and left symmetrical halves, but some delay or some hitch in the developmental process causes the right and left half embryos to separate and each half to grow into a whole individual."

Identical twins are always of the same sex in a pair and have the same or nearly the same eye color, hair color, skin color, nearly the same irregularities in their teeth, nearly the same finger-prints, nearly the same shapes of ears, nearly the same features, body build, etc.

"There is an old problem that badly needs solution, namely, which is more important in the development of an individual, differences in heredity or differences in the environment," Professor Newman said. "If we could find two individuals with exactly the same heredity and rear them under different environments we could conclude that the extent to which they remain similar is a measure of their heredity and the extent to which they become different under different environments is a measure of the effectiveness of the environment in producing differences. It is in just this connection that identical twins come to our aid, for they represent for each pair two individuals with identical heredity.

"So far we have studied five cases of identical twins reared apart. The results indicate that the environment very distinctly modifies some physical characters such as weight, general health, etc., but does not alter others such as eye color, hair color, teeth and features. The environment profoundly modifies those characters described by the terms intelligence and personality. After full credit is given to the modifying effect of environment, the fact stands out sharply that hereditary resemblances remain most strikingly close.

"I earnestly wish we could find and study about five more cases such as these. If we had ten cases and they were as consistent as those already studied, we might be able to arrive at some very definite conclusions as to the relative effects of heredity and environment in producing human differences."

Any one knowing of cases of identical twins reared apart was urged to write directly to Professor Newman at the University of Chicago.

MEDICAL ADVERTISING

A CHANGE in the twenty-century-old code of ethics which now governs medical practice was suggested at the recent meeting of the American College of Surgeons by its newly-installed president, Dr. Allen B. Kanavel, professor of surgery in Northwestern University Medical School in Chicago.

"When we see the exploitation of the poorly informed public by charlatans and medical hi-jackers, we must meet with constructive suggestions the desire of ethical institutions and public-spirited organizations to eradicate this evil, must realize the distinction between advertising for personal and selfish ends and that for the education and welfare of our people, must acknowledge that the principle of protection of the public for which our code was established may be better served by some change in our conception of the application of our rules," Dr. Kanavel declared.

Minds free from "guild arrogance, guild complacency and guild fundamentalism" are needed to solve the problem of giving the public competent medical service at a price it can afford to pay, Dr. Kanavel pointed out.

"There is some justification for fundamentalism in social concepts but none in science," he declared. "Contract practice is probably the most important question confronting us to-day," he said in discussing schemes for solving the problem of medical economics. "It behooves us to give careful consideration to this so-called organization of individuals, industry and institutions to employ incompetent individuals for service."

He also suggested better cooperation between the public and the physicians. "A knowledge of the attainments of modern scientific medicine must not be the peculiar birthright of the physician but must become a part of the common heritage of the everyday citizen," he commented. "Far from resenting the inquiry of the public as to our aims and ideals, we must welcome the association of the constructive mind of the well-informed layman in the solution of the great problems and the application of our discoveries to the benefit of mankind."

THE CONCENTRATION OF THE SUN'S RAYS

A HUGE "burning glass" made of nineteen lenses each two feet in diameter, as well as nineteen smaller ones, will soon be in operation at the new Astrophysical Laboratory of the California Institute of Technology. With its aid, it is hoped, temperatures as high as those in the sun-spots, around 10,000 degrees Fahrenheit, will be attained, and astronomers will be able to study at close range how various substances behave when so heated.

The new instrument has been developed by Dr. John A. Anderson, of the Mount Wilson Observatory, who origi-

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nated the general design of the lenses, and Russell W. Porter, who worked out the practical details of a mounting for the instrument, so that it can follow the sun as it moves across the sky. The sun's light and heat first fall on the nineteen two-foot lenses, which, by themselves, would bring the rays to a focus at points twelve feet away. A set of eighteen mirrors reflects each beam to the center, where it meets the other beams. Before reaching the center, however, each beam passes through a smaller lens, seven inches in diameter, which concentrates it still further. The beam from the center two-foot lens passes directly into the second lens without reflection from a mirror.

At first, the large beam of sunlight which supplies the whole battery of lenses is ten feet in diameter, but at the final focus of the instrument it is reduced to an area the size of one's little fingernail, so that the energy is concentrated about 200,000 times. The material to be studied will be placed in an evacuated glass bulb, made large enough not to be melted by the intense heat. As the material vaporizes under the temperature—and no substance is known which will withstand it—it will give off light, which will pass into an adjacent dark room, where it can be analyzed by powerful spectroscopes.

The erection of the new Astrophysical Laboratory, of which the solar furnace will be part, is one of the steps in a new program being undertaken at the California Institute of Technology, in studying the phenomena that occur in the heavens. The 200-inch telescope, double the size of any existing at present, which is now under construction, is part of the same program.

SULPHUR FROM POPOCATEPETL

FOR the first time in twenty years negotiations are going forward for the privilege of taking sulphur out of the crater of Mexico's quiescent volcano, Popocatepetl, for commercial purposes. American interests are reported involved in the project.

The last important concession obtained from Mexican authorities for this purpose was granted during the administration of Porfirio Diaz and was held by his friend, General Gaspar Ochoa. Ochoa's operations were halted because of the revolution which broke out in 1910.

In the past the sulphur has been hauled up to the top of the crater in a large basket, which was accomplished by means of a rope and pulley. Usually it is carried from the crater to Tlamacas down the mountainside on the backs of Indians. Burros have been the means used to transport the sulphur, which is in the form of brimstone, from Tlamacas.

It has been found necessary to grant Indians working in the actual crater two days' leave between each day of work, because of the stifling sulphur fumes. The crater is three quarters of a mile wide and approximately five hundred feet deep. In the center is a small, emerald-green lake.

The brimstone which collects about the crater periodically catches fire, but only the surface of the brimstone burns. So-called eruptions of Popocatepetl within recent years have been proved by expeditions from the National University of Mexico to be nothing more than enormous amounts of smoke from the burning brimstone. Sulphur has been taken intermittently from Popocatepetl since the time of the ancient Aztecs, who used it for medicinal purposes. Two of Cortez' soldiers, in the sixteenth century, climbed to the crater and obtained sulphur for the purpose of manufacturing gunpowder.

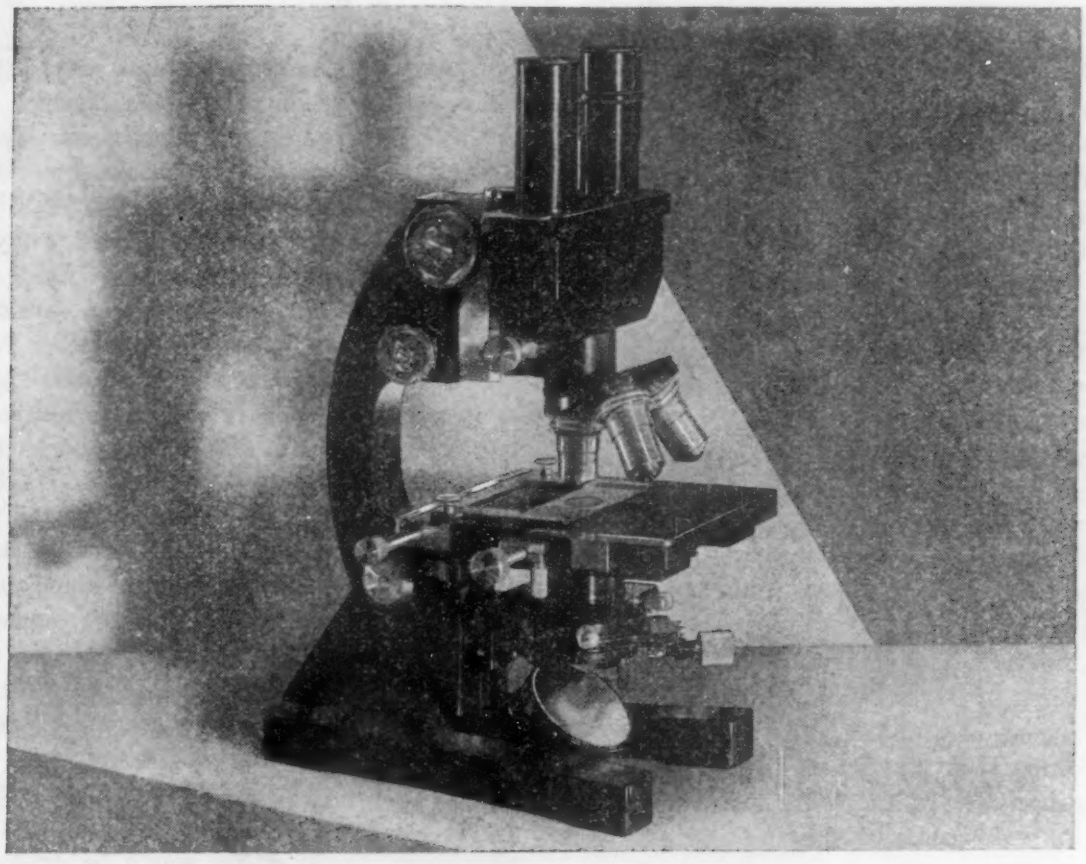
ITEMS

RED vinegar that looks like clear Rhine wine, smells like pear oil and tastes like old whiskey, comes from the pulp of the coffee-berry. About 40 per cent. of the berry is bright red pulp, 9 per cent. of that sugar and 8 per cent. tannins, Mr. F. W. Reise, chemist, says. Unripe mash made from the pulp contains acid, while overripe mash develops methanol from pectin. By-products have had little utilization. Coffee is the twin-seed of a cherry-like berry that grows on a bush.

INSECTS are better subjects for use in vitamin tests than are the conventional white rats and other larger laboratory animals. This is the claim of Dr. M. D. Sweetman and Professor L. S. Palmer, of the University of Minnesota, who have been trying out various foods on the larvae of a species of flour beetle. They gauge the insects' reaction to a given diet by the time elapsing between their emergence from the egg and the end-point of larva-hood, when they become chrysales or pupae.

A BOTTLE traveling ten miles a day in the water was the winner of a long-distance swim for bottles staged in Lake Michigan last summer by the U. S. Bureau of Fisheries. During the summer the steamer *Fulmar*, operated by the Fisheries Bureau, released 283 bottles in the lake, in an endeavor to determine the various surface tendencies of that important body of water. To make the investigation a success, it was necessary to depend upon the courtesy of the various bottle-finders in complying with a note inside asking that the bottle be returned to the bureau's office at Ann Arbor with information as to the date and place where found. The winner of the bottle race, released at St. Joseph, Michigan, was found 20 days later at Sleeping Bear Point in Leelanau County, 200 miles away. The information thus being gathered concerning the currents of Lake Michigan will be of value to commercial fishermen along the lake as well as to navigation.

DOGS with mottled teeth, an endemic condition of the enamel produced by the presence of fluorine in drinking water, have been achieved experimentally by Dr. Margaret Cammack Smith, of the department of home economics at the University of Arizona. Six months ago, Dr. Smith completed her experiments with the drinking water at St. David, Arizona, and determined that fluorine in the drinking water at that place was responsible for the existence of mottled teeth. At first the mottled condition was only produced experimentally in white rats, but now for the first time this condition has been given to the larger animals. The mottled condition has been produced after a six months' feeding experiment.



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PROFESSOR WARBURG'S WORK

CANCER, biological physics and the respiratory function of the blood are the three chief subjects of research by Professor Otto Warburg, of the Kaiser Wilhelm Institute for Biology, Berlin, who has just been awarded the Nobel Prize in medicine for 1931. Professor Warburg has made very important contributions in all three of these fields.

His work on cancer has probably attracted most attention. He showed that cancer cells have quite a different metabolism from ordinary tissue cells. They can get all the energy they need to live and grow and reproduce from the breaking down of sugar. Unlike other cells, they do not need oxygen but can live without it, as some disease germs do. This does not mean that cancer is caused by germs, however. It is the suffocation of normal cells by lack of oxygen that gives the cancer cells a considerable advantage in the competition of growth, according to Professor Warburg.

Professor Warburg also investigated the photochemistry of plant cells, that mysterious process by which the cells turn carbon dioxide and water into food in the presence of light. He measured very exactly the light absorbed by these green cells and compared it with the amount of carbon dioxide they used. He was then able to show a certain quantum relation between the two. This research of Professor Warburg's was one of the first pieces of work in which biological physics was compared with the quantum theory.

Other work of Professor Warburg's has been in the field of blood chemistry. He demonstrated the constitution and action of the ferment in the blood which controls the conveyance of the oxygen of the air from the lungs to the muscles and other tissues of the body. This substance, called the respiration ferment, was subsequently made in the laboratory by Professor Hans Fischer, of Munich.

ORIGIN OF THE PLANETS

THAT the earth and its brother planets were born when the sun was struck a glancing blow by a passing star ages ago, was affirmed by Professor Willem de Sitter, Dutch astronomer and "universe maker," in an address before the Washington Academy of Sciences and the Society of Sigma Xi.

An actual collision between the wandering star and the sun instead of a near approach is favored by Professor de Sitter as the most plausible explanation of the way in which the sun obtained its whirling family of satellites. Dr. Harold Jeffreys, British scientist, suggested this collision theory of the planetary system's origin, in order to explain the way in which the sun and the planets rotate on their axes. The idea that the planets were thrown out of the body of the sun by the attraction of another celestial body passing at a very short distance dates back to 1861. Professor de Sitter declared that the Laplace nebular hypothesis, which held sway for over a century, has now yielded to the collision theory of the origin of the solar system.

"The first result of an encounter would be that a filament of matter was drawn out from the sun towards the passing star," Professor de Sitter said. "This filament, after the star had passed away, would break up into different fractions, some of which would be large and constitute the planets, while a considerable part of the mass of the filament would either fall back on to the sun or be dissolved into a medium of gaseous molecular constitution, which would in the course of time partly fall down on the sun and planets and partly be dissolved into space.

"The effect of this medium on the motion of the planets would be to make the orbits circular as the result of friction. Those parts which would fall back on the sun would impart to the sun the momentum acquired from the passing star and thus produce the rotation of the sun in the same direction as the revolution of all the planets. The orbits of the planets would be very elliptical in the beginning and would only be reduced to circles gradually, due to the effect of the resisting medium and only at first perihelion passage in the elliptical orbit, the satellites would be drawn out from the planet by the action of the sun in the same way as the planets were drawn out from the sun by the star."

Professor de Sitter contended that this theory explains all the major features of the solar system, leaving only one difficulty, which is cleared up by assuming that the star actually collides with the sun. The actual collision would produce the rotation of the sun and the planets.

THE EXPLORATION OF SPACE

A "PALEOZOIC picture," a photograph made with light which is supposed to have started toward the earth 300 million years ago, was shown during a lecture at Princeton University by Dr. Edwin P. Hubble, of the Mount Wilson Observatory. It was a photograph of the most distant nebula yet studied by astronomers, and it was made with light that left the "island universe" on the fringe of known space at about a time when coal was in the making here on earth.

The achievement of a giant telescope in amplifying our knowledge of the material universe was depicted by Dr. Hubble in the Vanuxem lectures on "The Exploration of Space." Observational astronomy, once concerned chiefly with the solar system, then with the stars in our Milky Way or galaxy, is now, he declared, entering upon a third phase—the accurate description of the extra-galactic nebulae.

Thirty million of these, he estimated, lie within 300 million light years of our own galaxy. These thirty million nebular "neighbors" are scattered through this vast space more or less at random; but on the whole their distribution is homogeneous and isotropic, according to the careful statistical study he has been conducting at Mount Wilson. The hundred-inch reflector

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there can penetrate no farther into the depths of space, and speculative conjectures are our only guide at present when we consider what lies beyond the observational frontier, farther away than 300 million light years.

The principle of the uniformity of nature, when applied to this problem, may be interpreted in two ways, he suggested. The relativists usually assume that the homogeneity and isotropy of the observed region extend throughout the entire universe of space. But, as an alternative, it may be that, just as astronomers already have found a system of the planets and a system of the stars, so future observations with still larger telescopes may disclose a system of the nebulae. Long exposures with the greatest telescopes often bring out as many extra-galactic nebulae as stars.

MEASUREMENT OF THE INTENSITY OF X-RAYS

THE danger of burns during x-ray treatments has been greatly lessened, according to Dr. Lauriston Taylor, of the U. S. Bureau of Standards, by the completion and final testing of apparatus designed to measure the intensity of x-ray doses.

"Until now, no exact and uniform measurement of the strength of x-rays has been possible," it is explained by Dr. Taylor, who has just returned from Europe with the primary x-ray standard which he designed for the United States. "Now a doctor may calibrate his apparatus to learn the intensity of his x-ray doses without the necessity of guesswork. He will not burn his patient, nor will he commit the worse crime, in cases such as cancer, of undertreating him." There are two factors in x-ray treatment, the intensity and the penetrative power of the rays. The ray's penetrative power depends on the shortness of its wave-length, longer waves having a burning effect. The intensity of the x-ray dose is more important, and it is this intensity which he can now measure.

For three months Dr. Taylor experimented in European national standardizing laboratories, consulting foreign scientists and comparing his apparatus with theirs. Before that he labored at his instruments in the U. S. Bureau of Standards in Washington to construct a portable x-ray standard, finally building one which is so simple that he could take it with him, and so accurate and dependable that it is designated as the primary or final standard of the United States. This he compared with foreign instruments, drawing up with European scientists specifications for an international standard to remedy international confusion. This new apparatus is the only one in the world that completely satisfies these specifications, according to Dr. Taylor.

Uncle Sam's x-ray yardstick is in reality a small metal chamber into which x-rays are projected in a steady, uniform beam. When the rays pass through the air in this chamber they ionize the air, that is, set loose free electrons. This causes the air to become a partial conductor of electricity, which may be measured by an electric current and meters. The strength of this current depends on the strength of the x-rays.

France, Dr. Taylor reports, had been comparing x-rays with radium emission, but the x-ray intensity as thus measured varied with the ray's wave-length. The English laboratories did not guarantee steady and uniform transmission of the ray being gauged. The American apparatus does away with both difficulties, and furnishes as nearly as possible a means for transmitting, maintaining and measuring a ray of uniform and standard intensity, independent of all other conditions. For this reason France, Egypt and several other countries have adopted Dr. Taylor's specifications outright, and other countries have drawn up specifications which at present his apparatus alone fits. "It is now up to the bureau," Dr. Taylor affirms, "to find a means for gauging exactly the penetrative qualities of the various x-ray wave-lengths. The intensity of a ray used in medical treatment is but half the problem. Not until we have both standards can we call our standardization work complete."

THE USE OF DIESEL ENGINES

Is the time ripe for oil-burning Diesel engines to take the place of the gasoline power plants under the hoods of America's 27,000,000 automobiles? Even prominent automotive engineers give opposite answers to this question. Colonel George A. Green, vice-president in charge of engineering of the General Motors Truck Corporation, and Julius Kuttner, representing Oberhaensli Oil Engines of Austria, clashed on the subject before the national transportation meeting of the Society of Automotive Engineers in Washington, D. C.

Basing his conclusions on exhaustive comparative tests of one of the best heavy-duty Diesel engines now commercially available and on a gasoline engine having approximately the same displacement, Colonel Green declared that the Diesel has not been developed sufficiently to be applied with success to automobiles in this country. The chief operating disadvantages, he pointed out, are lack of rapid acceleration or pick-up and the giving off of a dense cloud of black smoke when running at full load, which precludes the operation of the engine in crowded areas. Other reasons why Diesel engines would not find a ready market were said to be higher first cost and maintenance, greater weight and size, roughness of operation and noise.

In the discussion which followed the presentation of Colonel Green's paper, Mr. Kuttner showed engineering curves made up from comparative tests on six Diesel engines and six gasoline engines which, he said, indicate that the Diesels have greater acceleration than the gasoline-burning engines. He suggested that Colonel Green might have reached different conclusions had he run tests on a number of different engines.

Colonel Green admitted that for heavy duty truck or coach operation Diesels will be satisfactory, except for smoking, and will result in marked fuel economy; but, he said, those who ride must be satisfied with less acceleration. Likewise the Diesel, with some other disadvantages, might be applied to passenger cars and trucks. But he contended that Americans have become so used to cars with a quick getaway that they will not tolerate those that are slower to speed up. "There is a splendid op-

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portunity for Diesels in aircraft and marine work,'' Colonel Green said, ''but further development is necessary before the Diesel engine can be satisfactorily exploited in this country as an automotive power plant.'' In his opinion, if the use of the Diesel becomes widespread, the engine will lose one of its great advantages, namely, fuel economy, because the cost of the fuel would certainly increase.

USES OF PINE TAR OIL

A POISON spray that cuts both ways, killing insects and checking the fungi that cause plant disease, has been made possible by the improvement of pine tar oil distilled from ''fat'' stumps and old logs in the southern states. It has been made the subject of study by Dr. E. R. deOng, consulting entomologist of San Francisco.

The light oil that comes off after wood turpentine has been distilled out of these forest waste products has long been known to possess insecticidal value. But it has hitherto been unsuited for general use on plants because it contained acids that poisoned the foliage and penetrated into the deeper tissues, often causing death. New processes now eliminate the acids, making the oil harmless to plants. The process is practicable on a commercial scale, Dr. deOng states.

Pine tar oil can be used for carrying various insect poisons, and in itself has insecticidal properties. Furthermore, it dissolves the wax on leaf surfaces, penetrating to the leaf tissue itself and carrying the dissolved insect poisons into more intimate contact than can be achieved with the usual petroleum spray bases. And since it is more volatile than the petroleum derivatives, it evaporates before it does the foliage any harm. When used where slower evaporation is desired, it may then be combined with any petroleum fraction.

A decided advantage claimed for pine tar oil as a spray base is its ability to carry in solution copper resinate, which is a compound of copper and resin, highly toxic to disease-producing fungi. Here again the ability of pine tar oil to dissolve the waxy covering on leaves comes into play, making it possible for the fungicide to reach the tiny accidental cracks and the minute breathing pores through which fungi usually gain entrance to the leaf.

ITEMS

BY shooting high-speed electrons into vapors of various organic substances, some new substances with larger molecules than the original ones have been formed at the University of Toronto by Professor J. C. McLennan and Dr. W. L. Patrick. Grain alcohol, methyl alcohol, formaldehyde, acetaldehyde and acetone, simple organic substances, were used in these experiments. Gaseous hydrogen, methane and carbon dioxides were formed by the later decomposition of the yellow complex compounds formed under the direct action of the rays. The initial clumping process, called ''condensation'' by chemists, is expected to assist in solving new problems of the structure of chemical compounds. Similar complex substances have already been formed by exposing organic vapors to the bombardment of radium gamma rays.

THAT the lumpiness of energy may be explained on purely mathematical grounds was suggested to the meeting of the American Mathematical Society at Columbia University on October 31 by Professor Edward Kasner, of Columbia, as a result of his studies of curves. An imaginary or complex mathematical curve, Professor Kasner said, has a peculiarity that a piece of it can never be made like a straight line, no matter how short a piece is taken. Professor Kasner studied the ratio between the length of a straight line cutting such a curve when the length of the piece cut off is made smaller and smaller, and found some curious things. In ordinary curves this ratio is one, but in the special cases considered by him the ratio can have only discontinuous values less than one, such as 0.94, 0.86, 0.80, etc. These values become realized when electrons are assumed to shoot out with the velocity of light and measurements are made in the space of Minkowski and Einstein. Jerkiness of this kind reminds one of the things observed in the quantum theory. Professor Kasner suggested that there may be some relation between the mathematical fact and the physical quantum laws.

AN asteroid discovered by Dr. K. Reinmuth, of the Königstuhl Observatory at Heidelberg, has attracted the attention of astronomers because of its unusual motion. With an average of three such discoveries every week, one has to be unusual to attract more than a passing interest. The new body, designated as 1931RA, is moving at a very slow speed through the sky. It would take nearly five days to travel the diameter of the full moon. Astronomers at the Rechen-Institut at Berlin, which keeps track of the asteroids, believe that this slow motion is due either to the fact that the new body is among the most distant, or else that it is moving with almost the same speed as the earth. In either event, the body is interesting, so astronomers have been asked to observe it further.

THE case of a native child who developed rat-bite fever after being bitten by a rat has been reported by Ana Vazquez-Colet, of the Bureau of Science, Manila, to the *Philippine Journal of Science*. The disease has been known for a long time in China and Japan and a few cases have been reported in the Philippines, but this is the first time that the organism causing it, *Spirocheta morsus muris*, has been found in a case here. The patient, a girl four years old, was bitten on the forehead by a rat while in bed. The bite healed, but a week later she developed fever and the skin around the healed bite became swollen and red. The fever came and went, with periods of about two days in between when there was no fever. She was brought to the Bureau of Science for Pasteur treatment. A few drops of blood and some bits of tissue were obtained from the forehead near the bite, and the organism causing the disease was discovered in examination of these specimens. The child recovered after about six weeks.

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW SYNTHETIC RUBBER

THE impending commercial production of rubber by E. I. du Pont de Nemours and Company, at a New Jersey plant, using coal, limestone, salt and water as raw materials, recalls the frantic and partially successful efforts of Germany's chemists to make synthetic rubber during the war. Cut off by the blockade from the plantations, Germany perfected a very similar process to that recently devised in Wilmington, Delaware, by the du Pont chemists, Mr. F. B. Downing, Dr. W. H. Carothers and Mr. Ira Williams. But cost was no barrier to the Germans when crude natural rubber was unobtainable, whereas the new American synthetic product, claimed to be in some respects superior, will have to compete with nature's efforts at six cents a pound.

Dr. A. von Weinberg, of the German dye trust, predicted in 1928 that synthetic rubber "would soon appear on the world markets as a commercial commodity, equal to natural rubber and cheaper in cost." The world is still waiting for the fulfilment of this prediction.

Fifteen years before this, just before the world war, the eighth International Congress of Applied Chemistry in New York City was enlivened by an acrimonious discussion between Professor W. H. Perkin, of Manchester, England, and Dr. Carl Duisberg, of Leverkusen, Germany. The English chemist claimed that he and his assistants had succeeded in producing rubber from potato starch and that they could repeat their laboratory success on a commercial scale. This the German capped by exhibiting a pair of automobile tires which had run a thousand miles and which were made of synthetic rubber.

Numerous patents have been taken out in the last twenty years for the artificial synthesis of rubber. All these patents cover two separate stages, the formation of a liquid hydrocarbon like "isoprene," obtained when rubber is distilled in the absence of air, and processes for coaxing the isoprene or similar molecules to condense with one another to form a rubber-like network. The second process, known to the chemist as polymerization, was first carried out by a French chemist, Bouchardat, as long ago as 1882 and has been repeated in many other ways since then.

In both the German war process and the du Pont process the first stage begins with production of the gas, acetylene, from calcium carbide by adding water. The acetylene is then combined with hydrogen and condensed to form a liquid called vinylacetylene closely related to isoprene, and that in turn is condensed to form chloroprene and then rubber.

The new du Pont product is claimed as superior to natural rubber in that it vulcanizes or hardens without the addition of sulphur, does not swell noticeably in gasoline and can be made to form a liquid similar to the tree latex, but superior in its ability to penetrate porous materials. A similar x-ray structure to natural rubber is found in the new rubber.

Isoprene is most easily made from turpentine, which it resembles chemically, but with turpentine costing about five cents a pound this is not practicable. It can also be obtained as one of the products of the Bergius process for liquefying coal. Kansas corn was proposed in 1925 by Professor James F. Norris, of the Massachusetts Institute of Technology, as a source of an isoprene substitute, methylbutadiene. In fermenting corn to form butyl alcohol, acetone is obtained as a by-product. The isoprene substitute is easily obtained from this.

Dozens of different other methods have been devised for each of the various steps of the synthesis. Numerous "synthetic rubbers" resembling the natural product in more or less degree have been made by these methods from time to time, but none has survived the test of price, as has the chemist's artificial indigo.

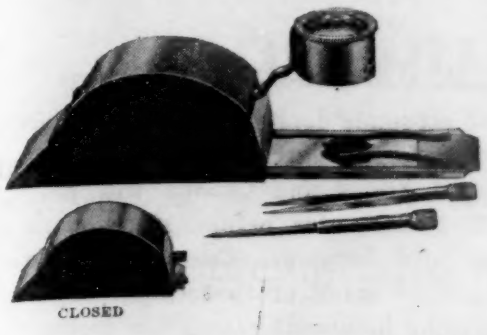
THE BENDIEN CANCER TEST

THE Bendien test for cancer, which was devised by Dr. S. G. T. Bendien, of Zeist, Holland, is still being investigated by leading British laboratories in the hope that a reliable method of early diagnosis may be available to the medical profession, although Sir C. Gordon-Watson, chairman of the investigation committee of the British Empire Cancer Campaign, has just poured cold water on these hopes. The test is not at present being applied clinically, and the scientists working on it stress particularly the fact that it is not in any sense a cure or a treatment of cancer.

Sir Gordon-Watson's opinion is that "although the preliminary results were encouraging, subsequent inquiries have failed to justify the early promise, and Bendien's method of diagnosis for malignant disease can not at the present time be accepted as reliable." All hope is not lost, however, and Dr. Alfred Piney, of the London Cancer Hospital, is continuing his investigation of the method.

When Dr. Bendien's test came to the attention of British medical authorities, the British Empire Cancer Campaign sent Dr. Piney, its secretary, to investigate. He carried 38 tubes of blood. Among them were bloods of many ailing patients, some suffering from diabetes, some from rheumatism, and a few from cancer. A few tubes contained the blood of healthy normal people. Dr. Bendien tested these blood-serum samples and when his findings were compared with the sealed diagnoses of the physician who collected the blood samples, they were found to correspond in every instance where cancer was involved.

Dr. Bendien's test consists of two parts, one chemical and the other spectroscopic. In the chemical test twenty tubes containing equal amounts of serum are treated with sodium vanadate in acetic acid solution of varying strength and hydrogen-ion concentration, and the turbidity or flocculation produced is carefully noted. With normal serum the flocculation begins in the sixth tube.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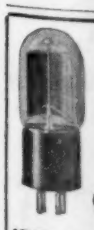

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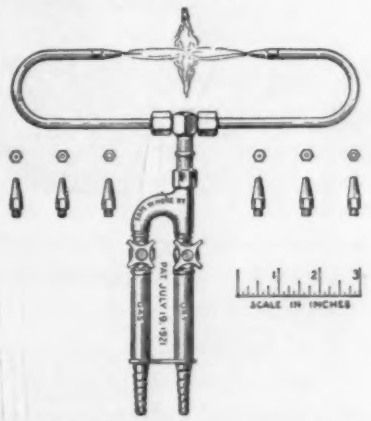

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With serum from patients suffering from cancer, tuberculosis and one or two other diseases, flocculation takes place in earlier tubes. To distinguish between those ailments, Dr. Bendien dissolves the precipitate from the chemical test in a 2 per cent. sodium bicarbonate solution and measures, by means of a spectrograph, its power to absorb ultra-violet light. It is stated that this "absorption spectrum" differs, according to the type of ailment, and Dr. Bendien claims that he can in this way distinguish cancer from the other diseases which behave in the same manner towards the chemical test.

Others have been investigating the test besides Dr. Piney. At the County Laboratory, Stafford, Dr. J. Fine has found that the chemical test gives good results. The spectroscopic part of the test seems to be much less reliable and involves the use of expensive optical instruments. Prior to Sir Gordon-Watson's statement the opinion of independent investigators on the whole has been that the test is far from infallible, but may be a step in the right direction.

VITAMIN ADVERTISING

HALF-TRUTHS in the advertising of vitamin content of foods are very likely to mislead the public, Professor H. C. Sherman, of Columbia University, authority on vitamins, warned in an address before the meeting of the Association of Official Agricultural Chemists held recently in Washington, D. C.

So-called "vitamin-rich" foods, said Professor Sherman, may actually be grossly lacking in the vitamins A, C and G, which are necessary in maintaining a buoyant state of health, though containing enough of vitamins B, E and D. Official chemists, he said, must tackle the problem of measuring the amount of each and all of these six or more chemically different substances in foodstuffs if they are to guard properly the nation's food supply. Commercial irradiation of foods with ultra-violet light, so widely advertised, increases only the vitamin D amount, and is where "we are most likely to meet the problem of what constitutes proper advertising of vitamin value in food," according to Professor Sherman.

Milk to which irradiated yeast rich in vitamin D has been added, he said, may properly be advertised as superior in its vitamin value, as milk itself is at all times a good source of all the other known vitamins. But this is not true of a food which is deficient in several of the vitamins.

Enough of a vitamin merely to prevent disease, Professor Sherman continued, is not a satisfactory standard for the American people. "We must conclude that of vitamins A, C and G we need, in order to do our best, amounts several fold larger than are needed to prevent the characteristic signs of deficiency or even to support fully normal growth. We want our people to have not merely enough to escape actual deficiency, but enough to enable them to do their best."

Hidden substitutes for milk or egg fat in manufactured food and imitation fruit juices were among the preparations mentioned by Dr. Sherman as preventing the attainment of optimum vitamin content in the American diet. The optimal amount is far above the minimal amount.

THE DEATH-RATE FOR 1931

IN spite of economic depression and an influenza outbreak during the early part of the year the death-rate for the United States and Canada will probably be lower for 1931 than ever before, statisticians of the Metropolitan Life Insurance Company in New York predict from their study of the company's records of deaths among the industrial population during the first nine months of the year. "Regardless, however, of whether a new low point in the death-rate is actually reached, the 1931 health record to date is in many respects the most remarkable of all the years," the company reports.

The records of the company showed that deaths for the first three quarters of this year are only three quarters of one per cent. higher than last year's all-time record minimum death-rate.

The death-rate for tuberculosis dropped 7½ per cent. If this continues to the end of the year, the largest year-to-year decrease registered for this disease in ten years will be recorded.

The diphtheria death-rate also dropped to a new low of 3.9 per 100,000, which is one seventh of the rate twenty years ago. New low death-rates for the year are also expected for typhoid fever, diarrheal conditions and conditions associated with childbirth.

Another unusual feature of the year's health picture so far is that there has been no rise in the pneumonia death-rate, in spite of the influenza outbreak and high mortality from that disease. The diseases which showed important increases during the first nine months of the year besides influenza are cancer, diabetes and infantile paralysis. The influenza death-rate returned to normal after last winter's epidemic was over. A further slight increase in heart disease was noted, which if it continues will make a new high point in the mortality from this cause.

MOLD INFECTION OF FRUIT

ORANGES and other fruits that suffer heavy spoilage from blue mold and other fungi can be saved from this loss by a new method for detecting mold-susceptible specimens, the invention of Rev. Hugh T. O'Neill, and Dr. Arthur J. Harriman, both of the faculty of the Catholic University of America, Washington, D. C.

The inventors discovered that mold infection always takes place through breaks in the skin, such as may be made by clipper cuts, the fingernails of the workers, box splinters, projecting nails, etc. A whole-skinned orange never spoils. They were able to demonstrate this point by keeping more than 400 sound oranges in a damp, dark cellar a period of three months (May 1 to July 30) without losing one of them through moldiness, though moldy oranges were kept among them to provide abundant sources of possible infection.

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Knowing thus that fungus spores can start trouble only if the skin is scratched or broken, the inventors next attacked the problem of making visible the microscopic nicks and scratches that escape detection in the grading as practised hitherto. They hit upon the scheme of using some substance that would enter these scratches and make a streak of contrasting color against the yellow skin. Of such substances, the most practicable is a metallic salt that will react with the tannin in the tissues just under the skin and form a dark, conspicuous substance. A salt of iron, preferably ferric chloride, is especially recommended. Any minute abrasion in the peel of the fruit is immediately made visible as a black line. Sound fruit is left entirely unmarked. All fruit, sound or unsound, is then washed in clear water so that all ferric salt is removed. The fruit then reaches the consumer without any substances that are poisonous or antiseptic. This obviates the use of borax, a substance much used to prevent blue mold infection but open to grave objection where such fruit is used to make marmalade or might be sucked upon by children.

Fruit found mold-susceptible by the new process would be culled out and sold for immediate use, or else used in canning or preserve-making or treated with a preservative. Father O'Neill, together with Dr. Harriman, has taken out patents on the process. Several of the leading fruit-packing firms have become interested in its commercial application.

ITEMS

A GROUP of faint nebulae, just visible through the large reflecting telescope of the Bergedorf Observatory in Hamburg, has been discovered by Dr. Walter Baade. He believes them to be considerably more distant than another group of faint nebulae, like those in the constellation of Ursa Major, which he discovered several years ago. These have been shown, by astronomers at the Mount Wilson Observatory, to be about 70,000,000 light years distant. Only one more distant group of objects has been measured—some nebulae in the constellation of Leo, which appear to be about 105,000,000 light years away. If the new Ursa Major group is more than this, it will be the most distant object known to astronomers. The newly discovered nebulae are within a distance of about half a degree of the star Merak, the pointer farthest from the pole star, at the corner of the great dipper diagonally opposite the handle.

THOUGH so faint that it can only be glimpsed in the very largest telescopes, Neujmin's comet, first observed in 1913 and now on its first return to the neighborhood of the earth, is being carefully watched by astronomers. It is a great astronomical rarity, for it is a member of Saturn's family of comets, and the second one that has ever been observed more than once. According to the "capture" theory, the larger planets, Jupiter, Saturn, Uranus and Neptune, have captured comets as they were moving through space. That is, as the comets came within the gravitational attractions of these bodies, they were pulled inwards enough to make them part of the solar system. They still show the identity of their captor, according to this theory, by making a close approach to the orbit of that body on each of their trips around the sun.

CALIFORNIA will probably have a drier winter than normal this year. This is indicated by studies just completed by Dr. George F. McEwen and Dr. A. F. Gorton, of the Scripps Institution of Oceanography at La Jolla. Observations over a considerable period of years have shown that offshore water temperatures higher than average are followed by winters drier than average, and, conversely, lower offshore temperatures indicate wet winters. This year's offshore temperatures have been appreciably above ordinary. The indication of the water temperatures is reinforced by the position of the 1931–32 season in what is known as the Brückner precipitation cycle. This is a long, gradual swing from wet to dry weather and back again, the total period being from 22 to 33 years. Indications are that this season is the low point of the long precipitation cycle.

AN enzyme has been found in liver which transforms carotene, the yellow coloring matter of carrots, into vitamin A, Mr. Harold S. Olcott and Mr. Duane C. McCann, of the State University of Iowa, have just discovered. The fact that carotene, which is found in other vegetables besides carrots, was changed to vitamin A in the body has been known for some time. The transformation has never before been performed outside the body, however. Preliminary experiments showed that carotene was destroyed and vitamin A appeared when carotene was kept in a warm place for a time with fresh liver tissue from the bodies of rats that had lacked vitamin A. It was supposed that the reaction was due to an enzyme. Further research, using a liver extract instead of fresh liver, proved this to be the case. It is suggested that the new enzyme should be called carotenase.

THAT radium to the value of hundreds of millions of dollars has been discovered in Canada, is the opinion of competent mining experts. The pitchblende bearing $150 worth of radium in every pound of ore, discovered by Gilbert Labine and Shirley R. Cragg, airplane prospectors, of the El Dorado Mines Corporation at Labine Point in the Great Bear Lake region, is equal in richness to the best ores of the Belgian Congo, which since 1922 have driven all competitors from the market. The new ore is described by geologists as "a very substantial deposit of high-grade material," yielding three to four grams of radium per ton. Twenty tons have already been shipped on a fur steamer of the Mackenzie River and forty more tons have been mined. Hundred-pound lumps were picked up on the surface. The radium from these will yield $70,000 a gram. Silver ore yielding $300 a ton has been found alongside. The Canadian discovery, consisting apparently of several thousand tons of ore, will add greatly to the world's present 600 gram total supply of radium.

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SCIENCE NEWS

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NEW ARTIFICIAL RADIATION

WITH the production in Germany of million-volt gamma rays of intensities that approach those of the cosmic rays and with the possibility of twenty million volts being produced at Princeton, Professor Arthur H. Compton, of the University of Chicago, stated that it might eventually be possible to tap the internal energy of matter and put it to work. A new idea as to how the energy stores of the sun are supplied was advanced by Dr. Compton at a conference in New York City sponsored by the American Institute of Physics on November 10.

An experiment by Dr. Walter Bothe, German physicist, was heralded by Professor Compton as "remarkable" and as accomplishing what has long been "considered an impossibility." On his recent trip to Europe, Professor Compton learned that Dr. Bothe has been able to produce artificial gamma rays by bombarding beryllium metal with alpha rays. These artificial gamma rays are an approach to artificial cosmic rays. They are the same kind of radiation as light and x-rays, except that they are much more penetrating. The beryllium metal from which they were obtained is the lightest metal that can be used practically, and the alpha rays that were used by Dr. Bothe in the bombardment are speeding hearts of helium atoms given off when radium and other elements disintegrate radioactively.

The amazing result of Dr. Bothe's experiment, as explained by Dr. Compton, is that there is obtained from the bombardment of beryllium, through the giving off of the artificial super-gamma ray, much more energy than was supplied by the attacking helium atom heart. This is interpreted to mean that what happens is not the disintegration of the beryllium but an actual process of synthesis in which a heavier element, carbon, is formed and energy is liberated in the form of the artificial "soft" cosmic rays.

If that is so, the hope of obtaining energy from such artificial synthesis is due for a revival. There is hope also that one element can be changed into another and that the age-long wish for transmutation may be fulfilled.

The practical application of this possible new energy source is made difficult by the fact that only one in fifty thousand of the projectiles hurled at the beryllium hits its mark and the process is therefore inefficient. Although there may be places in the universe where the synthesis proceeds at a much faster rate, the physicists are not optimistic about making this energy source competitive with coal, oil and water-power.

But conditions in the sun may be different, and the theory is advanced that solar energy that warms and lights our earth may be the result of synthesis in the sun rather than the present favorite theory of the conversion of matter into radiant energy. This idea carried to its logical conclusions may greatly affect all ideas of how the solar system and our earth originated.

In testing these latest physical theories and providing more powerful electrical tools, a new electrical generator developed at Princeton University by Dr. Robert J. Van de Graaff, now of the Massachusetts Institute of Technology, will be useful. A large generator to be built in an airship hangar near New Bedford, Massachusetts, is expected to produce ten to twenty million volts. A model built at Princeton gave one and one half million-volt sparks that jumped three feet.

Simplicity marks this new method of producing previously unattainable direct current voltage. It operates on the ancient principle of static electricity, that is utilized when you obtain sparks from a cat's back or scrape your feet across a rug and then touch metal. In the large generator the operator will sit inside one of two fifteen-foot-diameter electricity-collecting spheres, and although he will be charged with from five to ten million volts, they will not harm him because he will not be grounded.

Professor Compton, as the result of his survey of present knowledge of the atomic nucleus, believes that "we may have to find some fundamental principles of the physical world which are as yet unknown" before the nucleus can be understood. He recalled that the Danish physicist, Professor Niels Bohr, has suggested that perhaps the principle of the conservation of energy, long considered the foundation rock of modern science, is not obeyed when electrons are ejected from atoms.

INFANTILE PARALYSIS

INFANTILE paralysis, epidemic in New York and New England this summer and fall, affects more frequently children who are brunettes, have mongoloid eyes, deeply pigmented skin, wide faces with widely separated eyes, irregular teeth, and certain endocrine deficiencies, according to Dr. George Draper, professor of clinical medicine at Columbia University.

"So far as the paralytic symptoms of poliomyelitis are concerned," Dr. Draper said, speaking at a conference in Albany, sponsored by pediatricians of New York and Canada, "the child is more important than the virus of the disease itself."

Dr. Draper's demonstration of the influence of bodily constitution on susceptibility and severity of this dreaded illness may provide a means of selecting children who can be given special preventive attention during another epidemic.

Dr. Thomas Parran, Jr., state health commissioner, reported that over 140,000 cubic centimeters of human convalescent serum were prepared and used for treatment during the epidemic in New York State. Twice that amount of human blood was collected to make the serum. Nearly 2,000 cases occurred in New York State outside of New York City, where over 4,000 were reported.

Under the leadership of Dr. William H. Park, director of the New York City Health Department Bureau of

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IN this new book Professor Hancock has given us a scholarly and stimulating treatise written from the heuristic point of view. His purpose has been to offer an approach to a higher and more generalized arithmetic through a systematic study of the algebraic numbers, and to show how the field of rational numbers is broadened by their introduction. In particular he has attempted to juxtapose and harmonize Kronecker's and Dedekind's classical theories of ideal numbers and to place the work of later mathematicians—such as Minkowski, Hilbert, Hansel, Hurwitz, and others—in proper relation to these earlier studies.

While the work follows the Dedekind treatment, which is purely arithmetical, rather than that of Kronecker, it sets forth the final fundamental results from both these entirely different standpoints, in that the ideals and moduls of Dedekind are put in juxtaposition with the fundamental form and equations of Kronecker, the discriminant and order-modul being their final vantage ground. While the Dedekind theory is presented in its entirety the Kronecker theory is everywhere emphasized.

The author introduces preliminary notions of realms of rationality, reducibility in such realms, linear forms, bases, discriminants, and so on. The theory of quadratic realms is given in detail, the treatment of the integers in this realm serving as a stepping stone from the usual theory of rational integers to the general theory of algebraic numbers which the author will treat in another volume.

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Laboratories, every poliomyelitis case in the metropolis was visited by specialists drafted for the purpose. This special inquiry fails to show that in general the cases treated with convalescent serum progressed any better than those not so treated, although there was no evidence found that such serum injected intramuscularly did any harm. Dr. Lloyd W. Aycock, director of the Harvard Infantile Paralysis Commission, made carefully controlled clinical experiments on the use of serum, giving serum only to every other case that came to the hospital, but he reported that his results also were inconclusive.

Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York, explained that the fact that the virus causing infantile paralysis can not be seen does not mean that nothing is known about the disease. He suggested that the infection is introduced through the nose and that the victim must come into actual contact with someone carrying the disease. The nasal tract secretions are the most likely infective material.

Compared with 1916, when 21 out of each 100,000 died of the disease, this year's epidemic was mild, with only 8 deaths per 100,000. This may be due either to a milder form or a wider recognition of the disease by doctors.

INFLUENZA

A SCHEME of preparedness for the next influenza epidemic was strongly urged by Dr. I. S. Falk at a meeting in Washington of the Washington branch of the Society of American Bacteriologists. Dr. Falk, who is now on the staff of the Committee on the Cost of Medical Care, discussed the causes of influenza and described his own investigations on the subject made at the University of Chicago.

"If a virulent epidemic of influenza came upon us this winter, or at another time, we should not be much less helpless before it than in 1918," according to Dr. Falk.

The outlook for the next decade or so will not be very hopeful if further study of the cause and prevention of this disease are left to the casual development of research projects.

"There is an obligation upon public health authorities to provide carefully prepared personnel and facilities, located in strategically placed areas in the country, each with a carefully prearranged plan of study to be undertaken on the approach of an epidemic.

"Such a program does not necessarily conceive that the several research groups should sacrifice that independence of method and performance which is ordinarily essential in the prosecution of true research. It does require, however, that some suitable, central, authoritative body should take the necessary steps to insure that adequate preparation be made for the conductance of studies as effective as the state of knowledge requires."

Dr. Falk's theory of the cause of influenza is based on his and his associates' findings in Chicago during the 1928–1929 epidemic, when they isolated a germ from influenza cases which produced in monkeys a disease similar to influenza in man. This germ was a type of coccus. During the experiments it apparently lost its virulence. In further research, Dr. Falk was able to dissociate or separate this strain of germ into three types, one of which retained sufficient virulence to produce the disease. Dr. Falk suggested that spontaneous dissociation of this type occurring in the influenza germ may be responsible for the development of the disease. When the germ is in its virulent stage it may be the source of epidemics. In between epidemics it probably is present in the non-virulent form.

TRANSMISSION OF INFECTED MOSQUITOES BY AIRPLANES

PLANES from the tropics will probably carry on their sides, along with the fire extinguishers, spray guns for killing insects. This innovation is to be expected as a result of studies of mosquito transportation by airplanes, recently announced by the U. S. Public Health Service.

Because a certain type of mosquito carries the virus of yellow fever, which still occurs in parts of South America, the Public Health Service investigated the possibility of their bringing the disease in planes to the United States.

Dr. T. H. D. Griffitts and J. J. Griffitts, of the U. S. Public Health Service, found that certain types of airplanes do carry mosquitoes. These investigators put stained mosquitoes onto planes leaving San Juan, Porto Rico, and recovered a certain number when the plane arrived at Miami, 1,250 miles away, that same day.

"With conditions at airports such as would permit of many mosquitoes getting aboard, it might be expected that approximately one fifth of the original number would be transported for a long distance—at least 1,250 miles—in one day with repeated landing and opening of doors, hatches and windows, and refueling, unloading and loading taking place."

Under normal average conditions about airports, heavy infestation of airplanes would not be likely, but even one infected or infective mosquito of the yellow fever type might be the means of starting an epidemic.

However, considering the small number carried by aircraft and the facility with which planes may be freed from mosquitoes, it is concluded that while the danger exists, airplanes can be efficiently treated so as to destroy mosquitoes and thus retardation of air traffic progress can be avoided.

The investigations were made with the cooperation of the Pan American Airways system on the three types of planes—Fokker tri-motor cabin planes; Sikorsky amphibian passenger planes and Commodore cabin planes —operating between the West Indies, the western coast of South America, Central America, Panama, Mexico, Jamaica and Miami, Florida.

EFFICIENCY OF THE RAILROADS

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This thought is gathered from an address given by William C. Dickerman, president of the American Locomotive Company, before the Franklin Institute.

Coming at a time when the railroads have been seeking higher freight rates, Mr. Dickerman's address emphasizes the great technical advances and economies the roads have made since 1920.

In spite of the fact that from 1920 to 1929 there was a reduction of 42 per cent. in the number of passenger-miles per year, this loss has been counteracted by savings and increased efficiencies. The loss of passenger-miles is not as serious as it at first seems because the bulk of the railroads' revenue is derived from freight, and freight revenue-ton-miles increased about 10 per cent. during the decade.

Mr. Dickerman said that railroad operating costs in 1929 had been reduced to nearly three fourths their 1920 value. The number of employees was reduced by 18 per cent., and 10 per cent. less coal was burned.

The concentration of trains into larger units and the expenditure of nearly $7,200,000,000 for capital improvements taking advantage of technical advances are held responsible for these savings. The number of freight cars decreased during the ten-year period, but their average size and their total carrying capacity increased. There are also fewer locomotives by 7,000, but as a group they have greater power, higher speed and make longer engine runs with less fuel consumption than they did in 1920.

"This technical experience with its background of research, invention and resourcefulness," Mr. Dickerman said, "may be expected to continue its unrelaxed efforts toward greater efficiency, whether to be secured through super-pressures in steam practice or in refinement of internal combustion power far beyond anything that commercially has been developed to date."

Mr. Dickerman believes that the most effective immediate economies to be achieved by the railroads will come from replacing 25,000 locomotives more than 20 years old—nearly half the total number in the United States —with modern up-to-date efficient locomotives. Leaders in practically all fields have long recognized what obsolescence means to the progress of industry. They have not hesitated to replace their prime mover equipment as more efficient apparatus has been developed. Mr. Dickerman believes that the same economic analogy holds good in the field of railroad motive power.

ITEMS

A NUMBER of diamonds have been found in gravel deposits in Michigan, Wisconsin and Illinois. While the majority of them are small, many diamonds of considerable value have been discovered. The largest so far reported found weighed 21½ carats. A great diamond field somewhere in the north is believed to be the source of these stray diamonds. Where it is—or was—no one knows. But undoubtedly at some time glaciers swept over it, carrying away with them some of the diamonds, and perhaps even sweeping away the entire deposit. As they moved down over the Great Lakes region they scattered the diamonds among the gravel they left in their wake. Attempts made to find this field have all failed. Probably if still in existence it is hidden in the great wild and inaccessible areas of Canada, and the search for it is on a par with the hunt for the proverbial needle in the haystack.

STRAY electric currents from street-car tracks may travel along nearby pipe lines and hasten their corrosion, but the currents which follow oil and gas pipe-lines for miles and miles do not speed up rusting and leaking. This is the conclusion of Mr. Stanley Gill and Mr. W. F. Rogers, research engineers with the Gulf Oil Companies, following a study reported in the scientific journal, *Physics*. It is well known that currents from electric railways often jump to nearby pipe lines and rapidly destroy the pipe. But the currents Mr. Gill and Mr. Rogers studied are found in pipe lines far from electric railways or other sources of stray currents and frequently follow the pipe for miles without getting larger or smaller. They called these "long line currents." The experiments which show that these currents are a negligible cause of corrosion also indicate that they originate in the action of soil on the pipe.

A SMALL five-foot model of the world's tallest building is being buffeted by seventy-mile-an-hour storms in the big wind tunnel at the U. S. Bureau of Standards as part of a study of the effect of wind on skyscrapers. The other part of the research consists in actual measurements of wind pressure at different levels on the Empire State Building itself, of which an aluminum model is a copy.

LITTLE cellulose spindles are no longer the smallest known units which make up the structure of a plant; spherical bodies, tinier still, have been discovered. These minute spheres, observed for the first time at the U. S. Forest Products Laboratory, measure about one fifty-thousandth of an inch in diameter. They were found through microscopic examination in the spindles which are larger structural units of the plant fiber.

THE monotony of the black and white of the U. S. Patent Office files is now to be enlivened by bright colors. The plant patents, recently authorized by act of Congress, will be issued in full color whenever the color is a part of the "invention" claimed by the horticulturist who has produced the new variety of plant. The two colored patents issued so far are for a white carnation with a delicate touch of yellow, and for a rose of deep pink. The necessity for putting out patents in color has set a new problem for the patent office officials, for color has never previously been required for any type of patent. Despite the great additional expense for printing, the office is not allowed by law to charge any more for copies of the patents, so it is planned to limit the sale of them to those who can show that they have real need for them.

The Journal of General Physiology

EDITED BY

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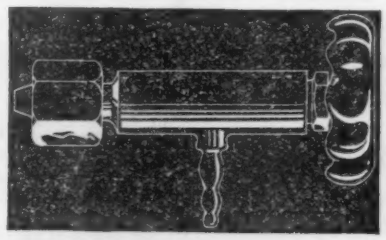

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SCIENCE NEWS

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THE NOBEL PRIZE IN CHEMISTRY

THE German winners of the Nobel Prize in chemistry, Dr. Friedrich C. R. Bergius and Dr. Carl Bosch, of Heidelberg, are two of the world's foremost practitioners of the magic of industrial science. Dr. Bergius has for many years performed marvels in the transformation of coal, changing it into motor fuel, lubricating oils, methanol (formerly known as "wood" alcohol) and other substances. He had developed a scientific theory on the things that must have happened to the plants of long ago to turn them into coal; and his latest feat has been to indicate the possibility of making sugar out of wood on an industrial scale for the manufacture of alcohol. A firm for the commercial exploitation of this process is already in existence.

Dr. Bosch, sharer of the prize, and head of the German chemical manufacturing firm, the I. G. Farbenindustrie, has specialized in the building up of cheap nitrogen into more valuable products, as his associate has worked on the building up of cheap carbon. Dr. Bosch's great achievement has been the perfection of a practical method for catching nitrogen from the air so that it can be combined with hydrogen to make ammonia by the Haber process. This in turn is used in the manufacture of fertilizers. Thanks to this process, blockaded Germany literally lived on air to a considerable extent during the war, and even captured from the atmosphere an indispensable ingredient for smokeless powder, TNT and other explosives.

Dr. Bergius was born in 1884 near Breslau, and studied at the Universities of Breslau, Leipzig and Berlin and the Technical University of Karlsruhe. Dr. Bosch was born in 1874 in Cologne, and studied at Cologne, Charlottenburg and Leipzig.

THE USES OF THE RESPIRATOR

FOR their invention of the respirator, which has maintained respiration and life in hundreds of infantile paralysis patients this past summer and fall, Professor Philip Drinker and Mr. Louis A. Shaw, of the Harvard School of Public Health, were presented with the John Scott Medal for 1931 at the Franklin Institute on November 18.

The respirator is a machine which was designed to replace manual methods of artificial respiration in cases in which the procedure must be carried out for long periods such as days or weeks. It was developed at the request of the Liability Insurance Fund of the New York Consolidated Gas Company.

At present there are some 150 adult type respirators in use in the United States and Canada and one each in London and Copenhagen. In New York City alone over a hundred cases of respiratory failure not caused by infantile paralysis have been treated with a high percentage of recoveries. These cases included severe carbon monoxide poisoning, drug poisoning, acute alcoholism, drowning, electric shock and the like.

During the last infantile paralysis epidemic, over 100 patients were treated in Boston, while in New York City, where there are twenty machines, Professor Drinker estimated that even more patients were treated. Of 180 cases of infantile paralysis admitted to the Children's Hospital in Boston, the death rate was only 4.5 per cent., probably one of the lowest in the epidemic.

The respirator has been used daily with good results in the after-care of patients who had originally been kept alive by its continuous use during the acute stage of their illness. The infant type, of which there are now about fifty in use, was designed for starting normal respiration in new-born babies who breathe with difficulty or not at all.

Professor Drinker described the respirator as follows: "The adult model consists of a sheet metal tank with a movable end. The patient lies on a comfortable bed with his body inside the tank and his head protruding through a loose fitting rubber disc or collar. By means of a suitable pump, a slight negative pressure or partial vacuum is created within the tank causing the patient's chest to expand and air to rush in through his nose and mouth. Pressure within the tank is then raised to that of the room, and the patient exhales in a normal manner. The depth and rapidity of the breaths taken by the patient are under control of the attending nurse, and can be altered at will."

PROFESSOR AARTOVAARA AND ELEMENT 87

BLINDNESS threatening Professor Gustave A. Aartovaara, of Helsingfors, Finland, in his search for the missing chemical element 87, has aroused the anxiety of scientists of the U. S. Bureau of Standards, who have been working with him in seeking one of the last two remaining building blocks of the universe. Glass fragments severely injured his eyes as a result of an explosion of his apparatus.

As a third competitor in the race to identify this elusive metallic element, Professor Aartovaara, of the Helsingfors Technical University, had sent a sample of his preparation to be examined by Dr. W. F. Meggers, of the U. S. Bureau of Standards, whose report on the optical spectrum has just been announced. The announcement comes on the heels of a rival claim by Professor Jacob Papish, of Cornell University, who declared he found the missing alkali in the rare mineral samarskite. The third contestant for the honor of completing the chemists' periodic table is Professor Fred Allison, of the Alabama Polytechnic Institute, who first announced the discovery of the missing alkali about a year ago, through the use of a magneto-optic method of his own invention.

No specific evidence that the Finnish preparation actually contains number 87 has been found, Dr. Meggers announced, though the spectra of all the related alkali metals, including sodium and potassium, were found. The crucial lines in the optical spectrum, he stated, will

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lie in the infra-red region where investigation is troublesome. In Dr. Meggers' opinion, only the x-ray spectrum, used by the Cornell investigators, can decide the question definitely. On the other hand, Dr. Meggers doubts if Professor Papish has given convincing measurements actually proving the existence of number 87 in his extract.

Professor Aartovaara's substance differs from those of Professor Allison and Professor Papish in that it is radioactive, as might be expected from its nearness to radium in the periodic table of chemical elements. The reported explosion that injured Professor Aartovaara is believed to have been due to the action of the radioactive rays on the solution. Chemists recall, however, that a radioctive alkali solution was examined in 1908 for the missing element by the German chemist, Ebler. None was found. The activity was due to a trace of a known radioactive element. Other similar hopes entertained by investigators about radioactive alkali preparations have all been unfulfilled in the past.

THE METEOR SHOWER

SHOOTING stars at a rate as high as one every twenty seconds were observed by Dr. Charles P. Olivier, director of the Flower Observatory of the University of Pennsylvania, during the Leonid meteor shower through which the earth has just passed. Dr. Olivier has just returned from Ulster County, New York, where he observed the Leonids from the estate of Mr. John A. Kingsbury, New York amateur astronomer. High in the Catskill Mountains, this location had perfect weather while the lower ground for most of the surrounding region was enveloped in thick fog.

The greatest display was seen early Tuesday morning, November 17, Dr. Olivier reported to *Science Service*. With the assistance of ten other observers, a total of 2,500 meteors was reported, but allowing for duplicates, there were probably about nine hundred separate ones visible from this location. There were a number of fine fireballs, including two with trains that lasted twelve minutes each. Professor Olivier himself observed 266 meteors, which came fastest during the half-hour from 3:30 to 4:00 A. M., when he saw ninety.

Professor Olivier is waiting for reports from volunteer observers throughout the country, and can not make a definite comparison between this year's shower and those of the past until these are studied. He stated, however, that he saw more meteors this year than he did in 1901, when the best display since the famous one of 1866 was observed.

Though not as fine as this year's, the shower of 1930 was also much better than for many years previous, so that now astronomers have more hope that 1932 or 1933 will bring a shower rivalling those of 1799, 1833 and 1866. Then the entire sky was said to be covered with meteors, like the ribs of a gigantic umbrella, all radiating from the constellation of Leo, the lion.

A return was expected in 1899, but did not materialize. It was later found that the previous gravitational attraction of Jupiter had switched the main stream of meteors aside so that it missed the earth. It is possible, however, that the swarm has been shifted back since then, and the fine displays of 1930 and 1931 make this seem more likely. Last year, as this, the main display was seen on the morning of the seventeenth, a day or so later than in the past.

THE COAL INDUSTRY AND THE ADVANCE OF TECHNOLOGY

FOR the presentation of the world's latest knowledge concerning a priceless gift of nature, scientists from fifteen countries have been holding in Pittsburgh sessions of the Third International Conference on Bituminous Coal. Dr. Thomas S. Baker, president of Carnegie Institute of Technology and host to the visiting scientists, said that "coal, the cheapest of our essential commodities, is now synonymous with economic distress and unhappiness. The scientist is striving to draw from it more substances which will be of service to mankind."

In spite of the fact that the coal industry is so in the throes of depression that the miner is poverty-stricken and the owner is suffering losses, conditions of this kind are not necessarily the result of technical advance resulting in the increased use of machinery, it was explained in an address by Myron C. Taylor, chairman of the finance committee of the U. S. Steel Corporation.

"It is commonly known," Mr. Taylor said, "that since the close of the war the high cost of labor has stimulated the use of labor-saving devices, but when we turn to the census reports for 1920 and 1930 we find that in 1920, 39.3 per cent. of the total population were engaged in gainful pursuits, while the 1930 census reports show that 39.8 per cent. of the total population were so engaged."

Competition from other sources of energy and from the development of better methods of combustion were cited by Mr. Taylor as causes of the coal industry's suffering. In 1913, he stated, 84 per cent. of the country's energy was supplied by coal while in 1929 this figure had dropped to 60 per cent., the remainder being furnished by petroleum, natural gas and water-power. It was also pointed out that the efficiency of public utility power plants has been more than doubled, that better combustion saves the railroads a quantity of coal each year and that modern coke ovens require annually 300,000,000 tons less coal than would be needed if old ovens were still in use.

"These figures," according to Mr. Taylor, "show the power of research and invention. What has been done in reducing the consumption of coal should continue to be stressed by the coal industry in bettering its production."

THE PART OF BACTERIA IN MAKING COAL

BACTERIA are working more than three thousand feet deep in the earth to revise those parts of the schoolboy's text-books that tell how coal was formed, while up on the surface cousins of the deep-dwelling bacteria, also new to science, are being made to take the poison out of illuminating gas, change hydrogen and carbon

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monoxide into acetic acid and the acid into methane gas, and to do for the research chemist many other strange tasks that may grow into important industrial processes. Thus may be summarized reports of some of the latest scientific investigations presented at Pittsburgh before the Third International Conference on Bituminous Coal, by prominent investigators from Germany, one of whom is Dr. Franz Fischer, director of the Kaiser-Wilhelm Institute for Coal Research in Berlin.

The widely held belief that coal was formed from ancient plants which, during geologic periods of time, first turned to peat, then to brown coal, then to soft coal and finally to hard coal under the pressure of thick strata of rock, is crumbling, according to Dr. Fischer. Coal was made from ancient plants, all right, but the part that bacteria had in its formation has been overlooked.

According to this view, which has been shaping itself for a number of years, hard coal did not necessarily have to become consecutively peat, brown coal and soft coal before assuming its final form. It might have been made in this fashion and probably often was, but if the right plant substances and the proper kind of bacteria were present the plant matter, with the help of the microorganisms, could have turned into hard coal, or any other kind except peat, by a short-cut method.

"Living bacteria may be found not only in brown coal deposited at shallow depths, but even in bituminous coal at depths of more than three thousand feet," Dr. Fischer said. "Whether these bacteria are still causing a further change in the coal can not be answered immediately. However, since they are living they must acquire energy for certain processes of metabolism. On the other hand, as they occur only in small quantities it is conceivable that in spite of the long period of time they are not of essential significance and that in the case of bituminous coal they do not contribute to the production of methane and the resulting explosions."

By way of studying further the new theory of coal formation, Dr. Ernst Terres, of the Institute of Chemical Technology at Charlottenburg, speeded up in his laboratory the geologic age-long process of making coal to just a little more than two years. Dr. Terres said that he fermented peat moss and then heated it under pressure to make artificial brown coal. He agrees with Dr. Fischer in part, concluding that the plant substance lignin, not cellulose, as is generally believed, is the material from which peat, brown coal and some bituminous coals are made. Dr. Ernst Berl, of Darmstadt, on the other hand, said that he has not been able to make from lignin a substance similar to coal, while he has satisfactorily produced artificial coals from cellulose.

Inspired by experiments with bacteria from coal mines, Dr. Fischer put some of their cousins from sewage sludge into an atmosphere of hydrogen and the poisonous gas carbon monoxide. Later he found that the carbon monoxide and hydrogen had disappeared, to be replaced by water and methane, an illuminating gas. Dr. Fischer noticed that in changing the poison, the bacteria formed an intermediate product, acetic acid.

ITEMS

THE Kennelly-Heaviside layer, radio roof of the world, has been shot to pieces by the recent Leonid shower of meteors, according to Dr. A. M. Skellett, of the Bell Telephone Laboratories at Deal, New Jersey. The meteors, bursting down into the atmosphere, lose most of their speed about seventy miles above the surface of the earth, at about the same region where ascending radio waves are turned back on their course by the Kennelly-Heaviside reflecting layer. A cloud of electrified particles accompanies every meteor in its descent. When the meteor enters the Kennelly-Heaviside conducting layer this disturbs the condition of balance so that the effective height of the layer is temporarily lowered. A fogging of radio signals results from this.

A WARNING to parents, physicians and health officers that a large increase in diphtheria cases is due this winter has been issued by the Medical Society of the County of Kings. According to previous experience with the diphtheria cycle, this winter will show a distinct upward trend in the number of cases of this disease. Health reports thus far bear out this prediction. For the week ending November 14 there were 2,584 cases of the disease reported to the U. S. Public Health Service by state health officers all over the country. This is an increase of about 100 cases over the total for the previous week, and of nearly 1,000 cases over the total for the corresponding week of 1930. An epidemic of this disease can be prevented by the thorough use of toxin-antitoxin or toxoid, which give protection against diphtheria.

THIRTY million dollars is being spent as the first move to clean up the most polluted harbor in the world, and the work that will cost that amount has been started on a new sewage disposal plant for New York. The new plant will treat a flow of 180 million gallons of sewage daily, purifying part of the tremendous stream of waste water which continually empties into the harbor and its branches, it will be revealed in the forthcoming issue of *Civil Engineering*, published by the American Society of Civil Engineers. Incorporating features of design applied successfully elsewhere, the plant will serve one fifth of greater New York. It will be located at Ward's Island in the East River, and several years will be required to complete it.

BLACKFOOT INDIANS will eat buffalo meat this winter. The "strong food" on which their warlike ancestors fed has been denied Indians as well as white men ever since the near-extermination of the bison at the end of the "Wild West" days. Now, however, the government-protected herds in Yellowstone National Park and elsewhere are more numerous than their natural range warrants, and surplus animals have to be disposed of every year. This year the Blackfoot on the reservation near Glacier Park, Montana, are facing a lean winter because grasshoppers and drought took too heavy a toll on their lands last summer. So Superintendent Aven Scoyen, of Glacier National Park has arranged to have one hundred old bison supplied to the Indians, to be killed for meat.

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SCIENCE NEWS

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GRAVITY, ELECTRICITY AND MATHEMATICS

UNIFICATION of the laws of electricity and magnetism with those of the gravitational field, a problem upon which Professor Albert Einstein and other mathematical physicists have been working, was given a possible solution by Professor Cornelius Lanczos, visiting professor of Purdue University, who made his announcement before the American Mathematical Society meeting at Columbus, Ohio, on November 28.

This new "field-theory" promises to arouse great interest in science circles because of the recognized need of linking Einstein's theories of relativity with magnetism and electricity. Previous attempts, even those announced by Einstein some two years ago, have not been considered wholly successful.

Professor Lanczos, who, as professor at the University of Frankfurt, Germany, is a countryman of Professor Einstein's, derived from the same principle two different functions, one of which leads to gravitation and the other to electromagnetism. Thus it appears that he has brought together the two diverse fields of physics that have heretofore developed so fruitfully along parallel lines.

The fascinating feature of Einstein's general theory of relativity, Professor Lanczos said, was that it gave a satisfactory explanation of gravitation on purely geometrical grounds. For this purpose, a new and curious kind of geometry, called Riemann's geometry, had to be introduced into physics in place of the long-familiar Euclid's geometry.

Professor Lanczos has made a further extension of the Riemannian geometry to physics. He makes the supposition that the "principle of least action," which has a very wide application in physical science, also exists in the Riemann space.

Two formulae result from this operation. One of these leads to the laws of gravitation. The other gives the new and consistent explanation of the laws of electricity and magnetism.

Thus a new theoretical basis for physics has been set up which welds several diverse fields into a whole. Previous attempts to generalize Einstein's point of view with respect to electromagnetism have met with great difficulties, according to Professor Lanczos. "At present, however," he stated, "no evidence has appeared which would tend to show a probable connection between this field theory and modern quantum theory."

BEHAVIOR OF THE ELECTRON

WHERE an electron is and how fast it is moving can be measured, but science can not tell exactly where it is going, Professor E. L. Hill, of the University of Minnesota, told the meeting of the American Physical Society meeting in Chicago on November 28.

Professor Hill restated the famous "uncertainty principle" which has so profoundly modified the conception of the reliability of physical science in recent years. The original uncertainty principle, enunciated four years ago, led physicists to doubt if future physical events can be predicted with complete certainty.

"According to the ideas of the new quantum mechanics, as they have been developed in the last few years," Professor Hill explained, "it is not possible to follow in detail the motion of an electron in the manner in which astronomers can follow the motion of the planets or the comets. Instead one can, generally speaking, only find the chance that an electron will be found at a given place or that it will move with a given speed.

"In 1927, Heisenberg, in Germany, enunciated his principle of 'indetermination' or 'inexactitude,' which states, among other things, that if an electron is known to be at a given point then one can not tell with what speed it is moving. This limits one very greatly in forming an idea of the way in which electrons behave. Following a suggestion made by the Russian physicist, Professor J. Frenkel, I have found that the equations of wave mechanics permit of a somewhat different interpretation, according to which an electron has a definite speed when it passes through a given point, but that one can not tell which way it is going.

"The speed which it has is just the speed it would have if it were governed by Newton's dynamical laws, but the inability to tell in which direction it is moving is a result of the fact that the electron obeys the laws of quantum mechanics instead of Newton's laws. This result somewhat lessens the structure of Heisenberg's principle, and makes the behavior of the electron much easier to understand.

"The details of this interpretation are not yet completed, and will require discussion by physicists before they can find general acceptance."

WAVES AND PARTICLES

THERE is no need to regard the electron as made of waves rather than as a particle, according to Dr. R. M. Langer, of the University of Minnesota, speaking before the American Physical Society.

Since the discovery, recently, that a beam of electrons can be diffracted by a metal plate like a beam of light by a grating, physicists have thought of the electron as being sometimes very unlike a bullet, which was the old idea of the electron. Electrons may behave sometimes like waves, sometimes like particles. The wave property of the electron, which has played such a large part in the recent revolution of physics, is not, Dr. Langer, said, necessary to explain any experiments so far performed.

"According to the present attitude," said Dr. Langer, "the old controversy between the wave theory and the corpuscular theory of light is unimportant because either one can be made complete and self-consistent. The same holds with regard to the theory of matter. However, the wave theory has had a certain advantage in the discussion of experiments on diffraction by gratings or crystals both for the optical and the electronic or atomic case. This advantage which was merely in the simplic-

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Some of the many changes incorporated in this fifth edition are: throughout the book, a special effort has been made to amplify or change those portions of the book which have been found troublesome. The chapters on Elementary Thermodynamics, Kinetics, Photochemistry and Atomic Structures have been rewritten. New chapters on Chemical Thermodynamics and an Introduction to the Quantum Theory have been added as these fields have become so important that even elementary students should have some acquaintance with them. The first half of the book has been made simpler, and the last half somewhat more advanced. Many new problems have been added.

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ity of the deduction of the diffraction formulae no longer obtains because with our newly acquired knowledge of the solid state, an argument originally proposed by Duane can be developed which makes the corpuscular description even simpler than the other. The important property of a solid body in this connection is that the electrons in it can take on only certain particular velocities or momenta. This property is sufficient to insure, for example, the selective reflection of light or electrons into definite directions without postulating any wave-like characteristics in the impinging electrons or light photons.

"The particle point of view is for many physicists an easier one to visualize and they will prefer to think entirely in terms of particles when they find that no unnecessary complications are involved in such a course. This will make it easier to interpret and devise new experiments. For many purposes a solid can be visualized as a structure through which many electrons surge back and forth. The atoms themselves will be unimportant except to give mass and shape to the system. The agents with which outside influences interact are the electrons and they determine what the nature of the interaction will be."

A CENTRIFUGE MICROSCOPE

A NEW type of microscope, that can watch what happens to living cells when they are whirled about at speeds up to ten or twelve thousand revolutions per second, has been developed by Professor E. Newton Harvey, of Princeton University, and Mr. Alfred L. Loomis, of Tuxedo Park, N. Y. As the result of preliminary calculations already made with its help, it is indicated that revision of existing ideas of some of the properties of living matter will be necessary.

Despite the fact that the cell is being whirled about, thousands of revolutions a minute, the new microscope presents the observer with a clear, steady picture of it throughout the process. The principle may be compared to that of a motion picture projector, with the whirling cell taking the place of the film and the eye of the observer the screen. By this mechanism a series of images is transmitted to the eye with such regularity and rapidity that they blend in a continuous picture.

A disc or turntable, about as large as that of a phonograph, is rotated at high speed by an electric motor. A hollow aluminum bar one half inch thick is mounted on the disc, extending along its diameter. Into this narrow bar the lower lens system of a microscope has been built. This is contained beneath an opening at one end of the bar and is, therefore, near the outer edge of the disc. Above this opening is placed the slide holding the cell which is to observed. By an arrangement of mirrors similar to that employed in periscopes, the image is carried to the center of the bar and is reflected upward through a second opening to the upper lens and the eyepiece of the microscope. This working end of the microscope is stationary, being supported directly over the center of the disc.

By this contrivance a means of constantly observing the cell when it is in motion is provided; but the image, if seen at all at a rapid speed, is only a blur. The problem of obtaining a clear image was solved by the adaptation of the principle of the motion picture projector.

When a light is flashed at regular intervals above the whirling disc, a movie-like series of images is produced. The light is so regulated that its flashes coincide with the passage of the cell beneath it. The flash lasts for approximately the space of one one-millionth of a second. It is produced by a small mercury light.

The new microscope is capable of developing 8,000 revolutions a minute, its speed being limited by the resistance of the air to the bar. In another model now in preparation, the bar has been stream-lined; this new model is expected to develop speeds of 10,000 to 12,000 revolutions a minute. At a speed of 12,000 revolutions the cell will be subjected to a centrifugal force 17,000 times greater than gravity. This may be compared to a pull of eight and one half tons upon an object which weighs one pound.

A NEW FORM OF VITAMIN D

A CRYSTALLINE form of vitamin D, more potent in its ability to prevent and cure rickets than any similar preparation now known, has been prepared by a group of investigators working at the National Institute for Medical Research in London.

The men who have made this remarkable scientific contribution are Drs. F. A. Askew, H. M. Bruce, R. K. Callow, J. St. L. Philpot and T. A. Webster. The leader of the group, Dr. R. B. Bourdillon, was prevented by illness from taking active part in the last stage of the work.

This new form of vitamin D is called "calciferol" by its discoverers. They say of it: "The antirachitic activity of calciferol is the highest yet recorded in known units for any preparation."

Calciferol has more of this antirachitic potency than the crystalline preparation of vitamin D recently reported by the German Nobel Prize winner, Professor Adolf Windaus, of Göttingen, Germany, the British investigators state in their report to *Nature*.

Professor Windaus has two vitamin D substances which he calls vitamin D_1 and vitamin D_2. Calciferol is not the same as D_1 but is much like vitamin D_2 in such physical properties as have been described. Professor Windaus' vitamin D_2, however, has approximately the same activity against rickets as D_1. In this it differs from calciferol, which has much greater antirachitic activity than D_1. Consequently it is concluded that the two substances, calciferol and D_2, are not identical.

Calciferol has been proved by them to be a direct product of the irradiation of ergosterol, known for some time as the parent substance of vitamin D. It has the same elements in the same relative proportion as ergosterol, although the structure of its molecule may be different from that of ergosterol.

A EUROPEAN PARASITE LABORATORY

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against the European corn borer, the great enemy of the largest American crop.

Established at Hyères in 1919, the laboratory, first under the direction of Dr. W. R. Thompson and then under that of Dr. H. L. Parker, has been quietly at work to discover what are the parasites of the corn borer in its natural habitat, the European continent, whence it was accidentally introduced into the United States.

Up to date, 33 species have been discovered, but only 15 of these have thus far been collected in sufficient quantity to do effective work in America. From the Hyères laboratory the parasites are sent to the U. S. Corn Borer Laboratory at Arlington, Mass., where they are bred, mated and released in the fields to attack and destroy the corn borers. When the parasites take hold successfully, shipments are made from Arlington to Toledo, Ohio, and Monroe, Michigan, whence distribution is made into the corn belt.

Southwestern France, northern and western France and the Po Valley in northern Italy are the regions which have contributed the parasites sent over to Arlington. However, observers are stationed at strategic points throughout Europe and even in the Far East to send corn borer parasites found in those regions to the Hyères laboratory where they are carefully examined to see whether they represent any new species.

In the case of most of the 33 species discovered, the parasites develop in or on the corn borer larvae and do their destructive work upon this stage of the insect. However, two species destroy the pupae of the corn borer in which they have developed, one species lives in the eggs and destroys them, while still another lays its eggs in those of the corn borer but they do not develop until the corn borer reaches the larval stage, when the attack begins.

The introduction of new parasites is only a part of the well-rounded scheme of the U. S. Department of Agriculture for leaving no stone unturned that will delay the spread of the corn borer in the great corn belt, Dr. Parker pointed out. Other main points in the program are the improvement of cropping methods, the destruction of corn stalks after harvesting, and the development of resistant varieties of corn.

Although the Hyères laboratory is primarily interested in finding parasites of the corn borer, it has also sent shipments to the United States of parasites of other economic insect pests such as the alfalfa weevil, the earwig and the European elm leaf beetle.

ITEMS

A "LOST WORLD" of plants is to be sought in the jungles of South and Central America by an expedition under the leadership of Dr. Ralph W. Chaney, of the University of California, and the Carnegie Institution of Washington, and participated in by scientific men from a number of American institutions. The party is to sail from Boston on December 22, and will return to California on February 27. The primary objective of the expedition is to find plants similar to those that grew in the subtropical forests of North America some sixty million years ago, during the period known to geologists as the Eocene. It is of course not expected that species exactly identical with the ancient fossils will be found, but strong similarities are confidently expected. A reconnaissance trip to Central America, made last year by Dr. Chaney, brought to light strong resemblances between the existing tropical jungles and the fossil forests of Oregon and California.

A COMBINATION of X-rays and a tiny camera which is lowered into the stomach now gives the physician or surgeon a means of determining more exactly the location of ulcers or other lesions in the stomach, Dr. P. E. Thal, of Chicago, told members of the Radiological Society of North America at their meeting in St. Louis. The camera consists really of two cameras, one above and one below an illuminating bulb, Dr. Thal explained. The whole arrangement is small enough to be passed into the stomach easily. A flexible tube from the camera carries the manipulating mechanism. Each camera has four film chambers arranged so that tiny photographs are made of four sides of the stomach walls. Thus eight pictures may be made at one time, covering the entire interior area of the stomach. By means of the X-ray, the physician can see the camera in the stomach and guide it to the best place to take the pictures. When all is ready, the exposure is made by opening the shutter and flashing the light. The films are treated like any other photographic negatives. The resulting picture tells the surgeon just where he may expect to find the ulcer he wishes to remove at operation.

X-RAYS as an aid in the early detection of certain glandular disorders were recommended by Dr. E. Kost Shelton, of Santa Barbara, California, at the meeting of the Radiological Society of North America. Dr. Shelton reminded his audience that a number of conditions arising from disordered function of the pituitary, thyroid and parathyroid glands, for instance, begin in childhood. Unfortunately, they are usually not detected until the patient is much older and the condition is far advanced, with consequent less chance for relief. However, these glandular disturbances have an effect upon bone development which, while it is not very well understood, may be observed with X-rays.

CHARLES H. DAVIES, mechanical engineer of Philadelphia, lost his leg in a mine accident when he was 11 years old. To-day his ideas, which have been recently patented, are revolutionizing the manufacture of artificial limbs. Shortly after the war, according to a report in the trade journal, *American Machinist*, Mr. Davies started making wooden legs. He found them clumsy and ill-fitting. Then he tried using various metals, but the riveted or welded joints were unsightly. Finally, he conceived the idea of using an aluminum alloy, made into a light, seamless tube. He invented a type of hydraulic press to "blow up" this tube to take the desired shape. Now the cost of metal legs is cut in half, and labor and time of production are reduced almost 100 per cent.

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By Victor F. Lenzen
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The revolutionary developments in physical science during recent years have stimulated an interest in the philosophy of science on the part of both philosophers and physicists. John Wiley and Sons accordingly take pleasure in announcing a new philosophical study of physical theory. "The Nature of Physical Theory," by Professor Victor F. Lenzen. This work is of especial interest since the author brings to his problem a professional training in philosophy, especially in logic and theory of knowledge. He is admirably equipped to interpret physics to philosophers and philosophy to physicists.

"The Nature of Physical Theory" is an intermediate book in that, although the subject is developed rigorously, it is expounded with a minimum of mathematics. The mathematical concepts employed are defined. The author has sought to provide philosophical students of science with a precise and dependable systematic logical analysis of physical theory. Thus the book stands between the popular expositions of physics and the specialized treatises for experts.

The program of the book is to analyze the concepts, principles and systems of physical theory by building up the system of physics inductively. The inductive development of physics is traced through the qualitative, operational and postulational stages by a method of successive definition and successive approximation.

A Physicist says: "The book is a unique and useful contribution to the literature of physics; unique because there is no other book in English which attempts the same thing, and useful because it gives in the briefest possible space the frame of ideas which every graduate student in physics is expected to acquire, and which almost every older physicist is struggling to understand."

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SCIENCE NEWS

Science Service, Washington, D. C.

DISINTEGRATION OF THE ATOMIC NUCLEUS BY COSMIC RAYS

THE incessantly penetrating cosmic rays that bombard the earth from the depths of outer space smash the hearts of atoms and let loose speeding particles, Dr. Robert Andrews Millikan, of the California Institute of Technology, announced in New York upon his return from a two and a half months' good-will trip to Germany and other parts of Europe.

Disintegration of the atomic nucleus by the cosmic rays was discovered by Dr. Carl D. Anderson, an associate of Dr. Millikan at the Norman Bridge Laboratory of Physics at Pasadena, in research planned jointly by Drs. Millikan and Anderson. The results were communicated to Dr. Millikan while abroad so that he might discuss their import with Lord Rutherford, of Nelson, and other physicists who have been studying atomic disintegration at the Cavendish Laboratory, Cambridge, for the past decade.

Dr. Anderson's experiments provide the first scientific evidence that electromagnetic radiation can disrupt the innermost structure of matter. Artificial breaking down of elements has been accomplished in the past by the impact of alpha radiation from radium, which consists of rapidly speeding hearts of hydrogen atoms. Heretofore investigators have not had at their disposal x-rays or gamma rays of sufficient intensity or shortness to disrupt the tightly bound hearts of elements.

Cosmic rays, with energies of 100,000,000 to 300,000,000 volts, are extremely penetrating x-rays or gamma rays and provide an automatic tool for bombarding and smashing the atomic hearts. In his experiments Dr. Anderson found that cosmic rays knock both negative and positive electrons and protons out of the nuclei of oxygen and nitrogen. He used the Wilson cloud chamber apparatus in which the collision of cosmic radiation with atoms of gas is made visible by a line of small water droplets. The electrons or particles of electricity that are reemitted from the collision travel at immense speeds —99.9 per cent. of the velocity of light, which is 186,000 miles per second. The protons or hydrogen nuclei also are given great velocities equal to half the velocity of light, or 75,000,000 volt electrons. These values provide physics with new speed records.

Dr. Millikan predicted that Dr. Anderson's bombardment experiments would be useful in understanding the fundamental nature of matter. It is another demonstration that transmutation of the elements, long considered an alchemistic dream, is possible in some cases. In Dr. Anderson's experiment, hydrogen, the simplest of elements, is obtained from the gases oxygen and nitrogen; although the quantities are of no practical importance.

Intensive research on cosmic rays now in progress in Germany is confirming, Dr. Millikan found, his conclusion that cosmic rays come to earth with equal intensity from all parts of the the sky. Dr. E. Regener, of the University of Stuttgart, by sinking electroscopes to thousand-foot depths in the Bodensee, has extended and confirmed Dr. Millikan's own finding on the penetrating power of the most intense cosmic rays. Dr. Millikan visited Dr. Regener during his travel in German-speaking European countries as the guest of the Oberländer Trust. He also found Dr. F. Hoffman, of Halle, in complete agreement with him on cosmic rays.

THE PHOTO-ELECTRIC CELL IN AVIATION

THE photo-electric cell, magic eye of science, has penetrated blanketing fog with an effectiveness thousands of times that of the human eye and so gives promise of enabling the aviation industry to overcome one of its greatest handicaps.

This and other important facts about aviation light signals have been learned from studies at the General Electric Research Laboratory by Dr. Irving Langmuir, who first filled the vacuum of electric lamps with rare gases to make them shine brighter and last longer, and his associate, W. F. Westendorp. They reported results of their work before the annual meeting of the American Society of Mechanical Engineers.

A device was described which, it was said, will enable a photo-electric cell on an airplane to "see" through dense fog light beacons on the ground entirely invisible to the eye of the pilot and thus enable the pilot to hold to his course. Its operation depends chiefly on the fact that the photo-electric cell is thousands of times more sensitive to diffused light—and all light from the ground will be diffused by fog—than the human eye.

To make sure that this super-sensitive electric eye will report airplane beacons and not just any lights on the ground, Dr. Langmuir and Mr. Westendorp suggested feeding special beacons with a 1,000-cycle current so that they will give a rapidly flickering light. Since other lights use either a 60-cycle or direct current, it will be possible to isolate the 1,000-cycle signals and use only these for direction purposes.

Indicative of the extreme sensitivity of the cell is the fact that in full moonlight it can detect a diffused modulated light of an intensity only one thirteen-thousandth of that of a diffused flashing light just visible to the eye.

In order to determine how well this system would work, a special set-up of the photo-electric cell and amplifier was constructed in the laboratory.

FILTERABLE BODIES SEEN WITH THE RIFE MICROSCOPE

USING the new "super-microscope" invented by Dr. Royal Raymond Rife, of San Diego, Dr. Arthur Isaac Kendall, of Northwestern University Medical School, has seen for the first time the exceedingly minute moving bodies that apparently carry the life of bacteria when these are induced to "dissolve" into a form that will pass through the pores of the finest porcelain filter and

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still remain alive and able to resume their microscopically visible bodies upon suitable treatment. The work was done at the Pasadena Hospital, and will be reported in the official publication of the California Medical Association, *California and Western Medicine*.

The material used by Dr. Kendall was a culture of the typhoid bacillus, ordinarily a fairly large germ, easily visible under the higher-powered lenses of a compound microscope. By feeding it on his recently-evolved "K medium," which apparently has the power of causing all visible bacteria to pass over into an invisible, filterable phase, Dr. Kendall induced the bacilli in his cultures to go through this change. Under the highest power of the ordinary microscope, he could see nothing moving in the fluid, except a swarm of rather active little granules that could be seen only as tiny motile points.

Examined with the Rife microscope, however, these points became plainly visible as small, oval, actively moving bodies, turquoise-blue in color. These appeared in all the cultures, and could be transferred from one culture to another through the fine-pored filters; so Dr. Kendall considers them to be the actual filterable forms of the typhoid bacillus.

He put them to another, more definitely crucial test. Reasoning that since they were all that were to be found in "K medium" cultures of more than eighteen hours' growth, he might find them in an intermediate state in younger cultures, he tried examining samples from cultures exactly eighteen hours old. In these he found both full-sized bacilli still unchanged, and his small, turquoise-blue bodies, and in addition there were peculiarly altered bacilli within whose substance the turquoise-blue bodies could be seen. These he holds to be bacilli caught in the act of changing from the filterable to the non-filterable phase.

This visual demonstration of the hitherto invisible, living and moving particles of the filterable phase of a bacillus is hailed editorially by *California and Western Medicine*. Of Dr. Rife's microscope the editorial says: "Whereas our present microscopes magnify from one to two thousand diameters, in this new microscope we have an instrument for which a magnification as high as seventeen thousand diameters is claimed. This is certainly a long stride from the initial efforts of Van Leuwenhoek, whose simple instrument may be said to have laid the foundation for the science of bacteriology which later came into being; and by means of which science much of the world's progress in man's conquest of the infective and other diseases has been made possible."

In the forthcoming article only meager details of the new microscope itself are given. It is made known, however, that all the optical parts are of quartz instead of the usual glass, that attachments make possible spectroscopic examinations and motion pictures of the material under the lens, and that magnifications up to seventeen thousand diameters are possible. The work on Dr. Kendall's filterable typhoid germs was done at a magnification of five thousand diameters.

The light used with Dr. Rife's microscope is polarized, that is, it is passed through crystals that stop all rays except those vibrating in one particular plane. By means of a double reflecting prism built into the instrument, it is possible to turn this plane of vibration in any desired direction, controlling the illumination of the minute objects in the field very exactly. Further details regarding the mechanical construction and the optics of the sensational new instrument are promised at an early date.

BLOOD TEST FOR CANCER

A NEW method of detecting cancer in its early stages has been developed by Dr. Hans Jacques Fuchs, member of the physiological institute of the Veterinary University of Berlin. An account of the new method has been given by Dr. Fuchs to a Science Service correspondent. Details will be published in a few months in a German scientific journal.

So far, two thousand cases have been successfully diagnosed by the new method, the diagnosis being confirmed by operation or dissection. The method also makes it possible to determine the presence or absence of cancer when an infectious disease occurs at the same time. Further, it is claimed that by this method the success of surgical or radiological treatment of cancer can be controlled.

The new method depends on the digestion of serum from the blood of a suspected cancer patient with fibrin prepared from the blood of a normal person and with fibrin from the blood of a person known to have cancer. The digestion goes on for ten hours at a temperature of 104 degrees Fahrenheit. The protein is then removed from these samples and the amount of non-protein nitrogen present in each is determined. Depending on the amount of non-protein nitrogen present, it is possible to make a diagnosis as to whether the suspected case is one of cancer or not.

The new method is the result of five years of incessant research work during the course of which Dr. Fuchs had to make a number of pieces of special apparatus in order to achieve the necessary exactness in his determinations. The method also marks the first time that a chemical determination of a serological process has been made.

A certain diagnostic test for cancer, such as this is hoped to be, will be particularly valuable because modern methods of treatment by surgery and radiation are chiefly successful only in the early stages of the disease. When cancer attacks the internal organs, it is nearly impossible to detect it in its early stages by present methods of diagnosis.

A NEW ANESTHETIC

A NEW general anesthetic for use in surgical operations, which is more rapid and efficient than ether, chloroform or the anesthetic gases, has been discovered in accordance with a prediction of Dr. C. D. Leake, professor of pharmacology at the University of California Medical School, according to an announcement made on December 4 by Dean Langley Porter.

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THE SCIENCE PRESS

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The new anesthetic is called divinyl oxide. It is chemically related to ether and ethylene and will probably be given in the same way that ether is. However, it is superior in several ways to these anesthetics.

Recovery is more rapid when divinyl oxide is used for an operation than when ether is used. There is less excitement and less nausea with the new anesthetic. There is also less irritation of the lungs and less disturbance of the body's chemical equilibrium. The heart action is not greatly changed. Divinyl oxide is a liquid which boils at a low temperature. It is inflammable and as explosive as ether.

Associated with Dr. Leake in the work leading to this discovery were Mrs. Mei-Yu Chen Mai, now in Peiping, China; Dr. P. K. Knoefel, fellow of the National Research Council, and Dr. A. E. Guedel, Los Angeles anesthetist. While investigating the anesthetic action of ether and ethylene at the University of Wisconsin, Dr. Leake predicted that divinyl oxide, the chemical relative of these substances, would prove valuable. At his request, it was produced in a chemically pure form by Dr. R. T. Major and Dr. W. L. Ruigh, of Princeton University, and the Merck Laboratory for Pure Research at Rahway, N. J. It was then given a trial and as a result the world has a new anesthetic.

Divinyl oxide may be obtained from the common garden variety of leek, but only by a laborious process. It has been found more practicable to obtain it by another method. Clinical evaluation of the new anesthetic is still proceeding at the University of California Hospital under the supervision of Dr. H. C. Naffziger, professor of surgery, and Dr. D. Wood.

The experiments leading to this discovery were made possible by financial aid from public-spirited citizens, chiefly the Christine Breon Research Fund.

ITEMS

THE cosmic rays have been seen. At least, the straight paths along which they travel have been made visible in experiments reported to the American Physical Society by Dr. L. M. Mott-Smith and G. L. Locher, of the Rice Institute, Texas. They believe, from their observations of these thin straight tracks of rapidly moving particles, that bullet-like corpuscles must form the problematical cosmic rays. The Wilson cloud expansion chamber, which has been used to investigate colliding atoms, was used in these experiments to make visible the path of the rays. They appear as a train of water droplets in a strong light.

PHOTOGRAPHIC plates sensitive to ultra-violet light will shortly be made commercially by a new process, Dr. C. E. K. Mees, of the Eastman Kodak Company, has reported to the Optical Society of America. "Schumann" plates used for this purpose till now were difficult to make and had to be prepared by hand. They had a coating either entirely free from gelatine or containing only a small trace of gelatine to bind the silver bromide together. R. E. Burroughs, of the staff of the Kodak Research Laboratories, tested a large number of organic substances and found the most suitable to be ethyl dihydrocollidine dicarboxylate, which fluoresces strongly in the ultra-violet. This substance can be applied in organic solvents, from which it crystallizes in microscopic crystals over the surface of the plate, these crystals being easily removed before or during development of the plate.

A NEW type of frozen fruit is being developed by the Food Research Division of the Bureau of Chemistry and Soils, Department of Agriculture. By pulping the pitted fruit, adding a sugar syrup, mixing it thoroughly and then freezing it at very low temperatures, department chemists have developed this frozen fruit product which they claim has a remarkably smooth texture and fully retains the original flavor. The experiments already have been made with excellent results with several varieties of fruit, and it is hoped that later results will measure up to the promise of these preliminary experiments. If so, ice-cream manufacturers and soda fountain operators will have a new and highly desirable fruit base, which also will be available for direct consumption in the frozen state.

MICHIGAN forest fire fighters last season developed a system of obtaining water for fighting ground fires by drilling shallow wells when no other near-by source was available. On many occasions it was found possible to sink a well from three to eight feet into the ground in a short time and thus obtain sufficient water to keep a ground fire or a muck fire under control. The use of this system, of course, depends upon the height of the water table. When it is low the pump system can not be used, but in ordinary seasons it has been found that a well point sunk a few feet into the ground will furnish enough water to fill portable tanks and pails. An ordinary "pitcher" pump or a gasoline pump is used to lift the water to the surface.

NEXT summer's grasshoppers are being fought this winter by the U. S. Bureau of Entomology. A survey is now in progress in the 'hopper country; this will be completed early in December, and it will then be known what steps will be needed to prevent a serious outbreak in the West and Northwest next summer. The normal method of stopping an outbreak of grasshoppers is to distribute baits of arsenic-poisoned bran where the young insects crawl the thickets, before they get their wings and move over a wide territory. The present survey should show where it will be necessary for private owners and state authorities to lay in larger supplies of the munitions of chemical warfare.

THE radium content of the pitchblende ore newly discovered in the Great Bear Lake region of Canada, has been incorrectly reported (see SCIENCE SUPPLEMENT, November 13, 1931). The pitchblende ore bears about $2 to $6 of radium per pound of ore. Assays of ore by the Mines Branch Laboratories at Ottawa showed between 71 and 213 milligrams of radium per ton. Assuming radium valued at $70,000 per gram, this is $5,000 to $15,000 radium gross value to the ton of ore.

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SCIENCE NEWS

Science Service, Washington, D. C.

DOUBLE HYDROGEN ATOMS

HYDROGEN atoms twice as heavy as usual, forming probably a new unit in the building of all other chemical atoms and throwing new light on the atom core, have been detected through the collaboration of Professor Harold C. Urey and G. M. Murphy, of Columbia University, with Dr. F. G. Brickwedde, of the U. S. Bureau of Standards in Washington, D. C.

The low temperature laboratory of the bureau, in which liquid helium was made for a first time in the United States some months ago by Dr. Brickwedde and others, assisted in the discovery of this new hydrogen isotope, which differs from ordinary hydrogen only in the weight of its atoms. By evaporating liquid hydrogen under a reduced pressure, and at the excessively low temperature of freezing hydrogen, 435 degrees below zero Fahrenheit, a partial separation of the heavier atoms was achieved. Professor Urey and Mr. Murphy then examined the heavier distillate in their spectroscope in New York and found a new series of "Balmer" lines that could only be attributed to hydrogen atoms of atomic weight two. Only one atom out of four thousand in ordinary hydrogen gas, however, he finds, is one of the new H2 kind.

Professor Urey himself had predicted last May that this hydrogen isotope of weight two would be found. His conclusion was drawn from a consideration of the relations between the numbers of electrons and protons in the known atomic nuclei. Independently Professor Herrick L. Johnson, of the Ohio State University, and Professor Raymond T. Birge and D. H. Menzel, of the University of California, had made the same prediction. Dr. Johnson followed practically the same reasoning as Professor Urey, while Professor Birge reached his conclusion from a comparison of chemical atomic weights and isotopic weights obtained direct by Dr. F. W. Aston in Cambridge, England.

Faintness of the spectrum or rainbow of the light emitted by the heavier hydrogen prevented previous seekers from observing the tell-tale lines, Professor Urey believes. Professor Urey did indeed observe these lines in the spectrum of ordinary hydrogen gas, but they were so faint that he could not be sure they were not "ghost" lines caused by irregularities in the apparatus used for detecting them. When in the low temperature experiments the proportion of the rare isotope was raised to 1 in 800, however, the H2 lines became visible near the regular lines of the "Balmer" spectrum. The nucleus of the new atom lies in weight in between ordinary hydrogen, weight one, and helium, weight four, both of them regarded as the units of which the cores of all other atoms are made up. The new H2 provides a new building block for atom nuclei, according to Dr. Brickwedde, and will be investigated with great eagerness by both chemists and physicists for the light it will throw on the way that the nucleus is built up.

The outside coatings of the new hydrogen atoms are identical in all respects, including chemical properties, with ordinary hydrogens. Only the mass of the nucleus is different. These two forms are not to be confused, however, with the symmetric para and unsymmetric ortho hydrogen atoms discovered in 1929 by Drs. K. F. Bonhoeffer and P. Harteck at the Kaiser Wilhelm Institute for Physical Chemistry in Berlin. These forms of hydrogen were of equal weight but different magnetic properties.

A new still will be made at the Bureau of Standards, which Dr. Brickwedde will use to attempt a more complete separation of the hydrogen twins. As the one is twice as heavy as the other he believes that this should be quite possible.

INTERSTELLAR ABSORPTION CLOUDS

THE distinction of living in the midst of the largest aggregation of stars in the universe was probably snatched from earth dwellers by Dr. Frederick H. Seares, assistant director of Mt. Wilson Observatory, when he reported to the Carnegie Institution of Washington that clouds of dust and gas in our galaxy dim the light of star clusters and thus astronomers were misled in thinking that they were farther away than they really are.

Instead of the stellar system in which our sun is a minor star being some five times the size of the largest spiral nebulae in the heavens, Dr. Seares believes that a correction for the absorption of light by interstellar gas and dust clouds will narrow down this difference, perhaps even showing that the galaxy around us is quite ordinary in size.

The portion of the universe in which the earth and mankind happen to be loses again a claim to distinction among the millions of other galaxies or "island universes" that giant telescopes reveal as dotting the heavens in all directions.

Present estimates that it takes light 200,000 years to travel across the diameter of our stellar system depend upon determinations of the distances of the globular star clusters, Dr. Seares explained. In these clusters of stars there are stars whose light waxes and wanes in regular periods. Some years ago it was discovered that the time of these stellar light variations was the key to the true brightness of the variable star. By comparing the real brightness and the luminosity of the star as it appears from earth, it was possible to find its distance. The so-called Cepheid variable stars thus became the yardsticks of the heavens.

By obscuring the light from these distant stars used as measuring sticks, Dr. Seares holds that the clouds of nebulosity in the plane of the Milky Way have so shortened the standard of length that it has given too high values.

Aside from its supposed larger size, the galaxy around us is so typical of the spirals that, Dr. Seares explained, "study of the spirals helps us to understand the galaxy." If we could look at the Milky Way and the rest of our galaxy from a point a million light years out in space it

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would look something like the great nebula in Andromeda or the famous Messier 33 nebula. It would have a great watch-shaped contour, stars scattered within, and great stellar aggregations, luminous nebulae and dark obscuring clouds located in the central plane of the galaxy.

Proof of Dr. Seares's inference that obscuring clouds are wide-spread over the central plane of the galaxy was aided by photographs made at Mt. Wilson Observatory by Dr. F. E. Ross, of Yerkes Observatory, working with a very efficient short-focus telescope lens of his own design. These photographs show more clearly than ever before that the rift running from the constellation of Cygnus to that of Circinus and separating the two luminous branches of the Milky Way is formed by dense absorption clouds.

AIR FILTER TO ALLEVIATE HAY FEVER

PEOPLE who suffer from hay fever will soon be able to have air filters installed in their homes which will remove irritating pollen from the air. Experiments just concluded at the University of Illinois Research Hospitals have demonstrated the practicability of relieving hay fever patients of distress by means of air filters. The filters used were adapted from the commercial form by Dr. William H. Welker and were used in an extensive series of experiments conducted by Drs. Tell Nelson and Ben Z. Rappaport.

People suffering from hay fever, according to Dr. Rappaport, were relieved of most of their symptoms in from one half to one and a half hours after entering a room in which the air had been drawn in from the outside through these filters. Patients who were used in these experiments slept well except on very hot nights when the room was uncomfortable because of the heat, but patients suffering from asthma were only partly relieved.

"Actually, very severe cases of hay fever who find life almost intolerable for two months unless they get away," Dr. Rappaport said, "are greatly benefited. The filtration is at best, however, as an adjunct to treatment by immunization."

People who are only partially relieved by immunization treatment, he pointed out, can be benefited by using in addition a filtering machine in their bedrooms, thus exposing them to pollen only when they must be out of doors. A good percentage of the 2,500,000 to 6,000,000 people who have hay fever in the United States can in this way be partially aided.

The experiments carried on at the University of Illinois Research Hospitals were conducted in one of the wards in which a machine was installed which drew air in from the outside through a number of paper filters. Over 100 persons were observed. Those with hay fever only were kept in the room at night and permitted to pursue their customary activities during the daytime. Patients with asthma were kept in the room 24 hours a day.

The hay fever cases were relieved of most of their symptoms in from one half to one and a half hours after entering the room. They slept well. The relief, however, was not complete, as most of them had a mild attack of hay fever in the morning on awakening.

The asthma cases caused by the fall pollens were only partially relieved, several not until they had been in the room four or five days. Their asthma returned a few hours after leaving for home.

Further work with improved filtration machinery is being planned by the University of Illinois group for next year.

TREATMENT FOR PELLAGRA

A METHOD of treating pellagra, based on a new theory of its cause, has been reported by Dr. Ibrahim Sabry, skin specialist to the Government Hospital at Alexandria, Egypt, to the London *Lancet*.

Dr. Sabry's method consists simply of daily injections into the veins of a small amount of a sterilized solution of a common chemical, sodium thiosulphate. The skin lesions which are a distressing feature of pellagra are checked in early cases after only a few injections and disappear quickly in late and lingering cases. Gangrenous limbs, sometimes seen late in the course of the disease, soon heal under this treatment. Other symptoms clear up as the disease yields to treatment. From 20 to 60 injections are needed. So far no complications whatever have been met with.

Dr. Sabry considers these facts sufficient grounds for contesting utterly the idea that pellagra is caused by vitamin deficiency, since no disease due to deficiency of a vitamin has ever been known to improve without supplying the lacking vitamin and certainly not from the mere introduction into the body of a drug that can not contain any vitamin.

Instead, Dr. Sabry believes that the symptoms of pellagra are due to presence in the body of a poison belonging to a chemical group having the name dioxyphenylalanine. This is closely related to tyrosine, which occurs normally in the body. He claims that the pellagra toxin which he calls "dopa" has been obtained from the vegetating seeds of beans. He therefore attributes pellagra in Egypt mainly to the consumption of beans.

Dopa may also occur in maize or any other cereal. It may get into the body by way of food, such as beans, maize or other cereals, or it may be formed in the body by the action of some parasite or "germ." Dr. Sabry is of the opinion that it gets into the body by way of the food eaten, and specifically from beans.

THE ORIENTAL LAND-LEECH

THE Oriental land-leech, known among scientific circles as the Haemadipsa (takers of blood) is found abundantly in the jungles, forests and mountain slopes of India. For years, residents of these sections, particularly in the vicinity of Darjeeling, explorers and hunters have complained of these pestiferous and uncanny animals.

Dr. J. Percy Moore, of the department of zoology of the University of Pennsylvania, has just returned from India where he has spent a year in the field studying their habitat, behavior and physiology. He was partially prompted to make this study because comparatively little is known of the land-leech, aside from the frequent accounts of their abundance in India and the annoyance they cause. Athough Dr. Moore has returned with a wealth of information, additional work will have to be

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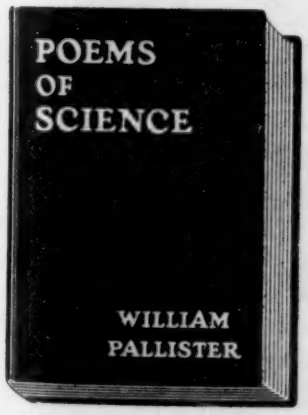

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carried on in the laboratory before a complete knowledge of the animal is obtained.

From his study abroad Dr. Moore has come to the conclusion that the land-leech has sense organs of touch, light perception and taste-smell. All three of these sense perceptions are used to ascertain the presence and position of their prey. A hungry leech in the field tends to move upward. This is known as negative geotropism. It will climb any plant or object with which it comes into contact and when the high point at the top of a blade of grass or a plant is reached, it will stop, and, attaching its posterior sucker firmly it will stretch its body to the utmost and with rather violent movements will reach in all directions. It is from this higher position and this reaching manner that it may possibly come in contact with its prey.

Dr. Moore experimented with the sense of smell perception of these leeches. Many times he watched them climbing. After they had been unsuccessful in coming in contact with him, they descended to the ground, moved to a closer stem, and repeated their climbing and stretching. After they had almost reached him, he carefully moved to a new position and noted that after some hesitation they changed their course and still followed him.

The Oriental land-leech, which thrives only on the blood of vertebrates, has an enormous appetite although it feeds only occasionally. Dr. Moore weighed some of them before feeding and after. He allowed them to feed on frogs or sometimes he allowed them to attach themselves to his hand and drink his blood. These experiments showed that some of them actually imbibed eleven times their own weight of blood. One feeding, however, may suffice for several months, for a year, or even for life.

ITEMS

A "BRASS BRAIN," that ferrets out cyclic variations in the amount of heat and light put forth by the sun, was demonstrated by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, at the meeting of his board of regents. It consists of a simple but ingenious arrangement of sliding brass pins on two wheels, which will automatically untangle a curve representing one period of activity from a compound curve in which more than one such period may be indicated. The device is intended for use in Dr. Abbot's study of the fluctuations in the amount of energy radiated by the sun. Many years of research have led him to the belief that these fluctuations are indirectly reflected in weather changes, and that eventually a reliable method for long-range forecasting may be based on them.

VERMONT will add another unit to the chain of northeastern seismograph stations. Plans for the installation of a Milne-saw seismograph of the most modern type have been announced by Professor Elbridge C. Jacobs, of the department of geology. The instrument will be set up in the new Robert Hull Fleming Museum of the University of Vermont. A grant for this purpose has been made by the National Research Council, and it is hoped to have the apparatus in operation by the fall of 1932.

A SUBSTANCE having remarkable powers of controlling the growth of living beings and of possible value in the treatment of cancer is being investigated in the laboratories of the Royal College of Surgeons of England and at King's College, London. The discovery is due to a young biochemist, J. H. Thompson, who has found that an extract of the parathyroid gland of cattle will restrict or prevent growth without endangering the health of the organism. The most important application of this discovery lies in the treatment of cancer. It is being tested in several London hospitals with very encouraging results. Sir Arthur Keith has further suggested that it may be of value in the treatment of the disease called acromegaly or gigantism which is due to abnormal functioning of the pituitary gland.

DON'T plant pure stands of conifer trees in forests that are being established or rebuilt, warns Eldred R. Martell, of the University of Michigan, in an article which will appear in the forthcoming issue of *The Journal of Forestry*. Pure stands of such evergreens, he claims, have a bad effect on the soil in which they grow, leaching it of necessary soluble minerals and causing the development of solid layers of "hardpan" that interfere with the circulation of soil water and prevent deeper penetration by tree roots. Mr. Martell holds that rain water, seeping downward through the littered needles on the forest floor, becomes acid, making it a too-efficient solvent of the mineral nutrients that should be left there for the feeding of the trees.

AMERICAN automobiles are losing popularity in the Philippine Islands. They are attacked by the little thread-like feeding organs of fungi. These organisms cause decay in the wooden parts of autos, with the result that the doors begin to sag and the top starts rattling or gives way entirely. Even upholstery is not immune. Most automobiles in the Philippines are American made, using temperate-zone woods. European cars are few, but many of them, to circumvent the fungi, use tropical woods which are not susceptible to fungous decay. Ravages of the fungi occur within the first or second year of the car's life. Spores of the fungi, spread by the wind, light on automobiles and germinate. Moisture necessary for the fungous growth gains entrance to the wood used in the car, usually at the joints. Assisted by hot weather and plenty of rainfall, the fungi grow rapidly. They send out cotton-like threads, secreting ferments, which spread throughout the wood tissues and destroy them. Two remedies are suggested by C. J. Humphrey, mycologist of the Bureau of Science, Manila, in a report to the *Philippine Journal of Science*. Resistant Philippine woods could be shipped to the U. S. for the manufacture of cars destined for the tropics, or American woods could be treated with substances, such as creosote, to render them reasonably safe from decay. All-steel auto bodies, of course, are in no danger from the fungi.

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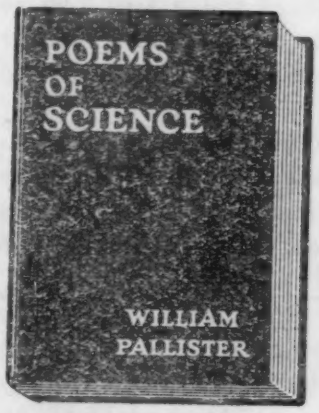

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME ADVANCES IN THE SCIENCES DURING 1931

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Physics

A SUCCESSFUL though inefficient method of tapping the energy of the atom nucleus to obtain synthetic cosmic rays was discovered by Dr. W. Bothe and Dr. H. Becker, of the University of Giessen, Germany, who bombarded metallic beryllium of atomic weight nine with alpha rays to obtain carbon atoms of atomic weight thirteen and of less energy.

The energy of the mysterious inner core of the atom is probably in quanta, or definite small amounts or parcels, just as it is on the outside, Drs. J. C. Chadwick, J. E. R. Constable and E. C. Pollard, of the University of Cambridge, discovered through a bombardment of atom nuclei with fast moving alpha particles from polonium.

X-rays can be made to produce a weak radioactivity in lead, causing its atoms to fly to pieces in a manner similar to the disintegration of spontaneously radioactive radium, according to experiments made by Professor G. I. Pokrowski, of Moscow.

New evidence for the theory that even atoms behave as though they were immaterial waves was secured when Dr. Thomas H. Johnson, of the Franklin Institute, Philadelphia, fired a stream of hydrogen atoms at the surface of a crystal of lithium fluoride and by observing the spread of the reflected atoms measured their wave-length.

Construction of a high voltage generator which it is hoped will generate as much as 20,000,000 volts to be built up through the use of static electricity on silk belts was begun by Dr. Robert J. Van de Graaff, of Princeton and the Massachusetts Institute of Technology, who completed a model giving 1,500,000 volts.

A verification of the famous Michelson-Morley experiment was performed at the Zeiss works at Jena by Dr. G. Joos, showing no ether drift through the atmosphere because of the motion of the earth.

A unification of the laws of gravitation and those of electromagnetism into a single mathematical theory, based on the famous "principle of least action," was proposed by Professor Cornelius Lanczos, of the University of Frankfurt.

An X-ray tube built to withstand voltages as high as 2,600,000 was made of alternate rings of paper, rubber and aluminum by Drs. F. Lange and A. Brasch, of the University of Berlin.

Dr. Gustaf Stromberg, of the Mount Wilson Observatory, demonstrated that light which has been on its way from the distant nebulae for some 70 million years is still traveling at the same speed as does light on the earth.

Tracks made by cosmic rays in a cloud of vapor were made visible by Dr. L. M. Mott-Smith and G. L. Locher, of the Rice Institute, Texas, who conclude from a study of the paths that the rays must be composed of bullet-like particles.

The completion of what is probably the world's most powerful microscope, capable of magnifications up to 17,000 diameters, was announced by Dr. Royal Raymond Rife, of San Diego.

Helium was turned from a gas into a liquid for the first time in the United States by a group of physicists at the National Bureau of Standards which included Dr. H. C. Dickinson, Dr. F. G. Brickwedde, W. Cook, R. B. Scott and J. M. Smoot.

A new theory which supplements the science of thermodynamics in fitting it to unexpected fluctuations at variance with the regularities covered by the second law of thermodynamics, was proposed by Professor G. N. Lewis, of the University of California.

The rate of expansion of the universe was derived from the fundamental equation of the modern quantum theory by Sir Arthur Eddington, British astronomer, who thus linked the size of the universe and the mass of the electron and made the reality of the astronomically observed recession of the nebulae more plausible.

X-rays were produced without the use of X-ray tubes by M. G. Reboul, of the Physics Laboratory, Montpellier, France, by driving electric currents through solids like magnesia, alum and yellow oxide of mercury, which have high electric resistance.

A computing machine for solving complex mathematical problems in the form of differential equations was made by Professor V. Bush, of the Massachusetts Institute of Technology.

Evidence that electrons move about at high speeds in solid bodies was obtained by Dr. Jesse W. M. DuMond and Dr. Harry A. Kirkpatrick, of the California Institute of Technology, through use of the Doppler effect.

An extension of the uncertainty principle to past events was announced by Professor Albert Einstein, Professor Richard C. Tolman and Dr. Boris Podolsky.

That the universe may be contracting and expanding in cycles of many millions of years without running the risk of a heat death through the operation of the second law of classical thermodynamics was indicated by studies on model mathematical universes by Dr. Richard C. Tolman, of the California Institute of Technology.

A gigantic burning glass, made of nineteen lenses each two feet in diameter and nineteen smaller ones, was designed by Dr. John A. Anderson, of the Mount Wilson Observatory, and Russell W. Porter, to concentrate the energy of the sun's rays as much as 200,000 times so that a temperature of nearly 10,000 degrees Fahrenheit may be obtained.

A new laboratory for the study of magnetic forces at low temperatures was added to the University of Cambridge, England, as the gift of the Royal Society of London.

Astronomy

A brilliant display of Leonid meteors, greater than any shower since the famous one of 1866, was observed in

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November of this year; astronomers predict another great shower in 1932.

The largest American-made telescope mirror, 69 inches in diameter, third largest in the world, was completed for the Perkins Observatory, from a two-and-a-half-ton glass disc cast at the National Bureau of Standards, Washington, ground to a curve correct to a millionth of an inch by J. W. Fecker, of Pittsburgh.

A new record for apparent heavenly speed was discovered by astronomers at the Mount Wilson Observatory when they found a faint nebula seemingly receding from the earth at more than eleven thousand miles per second.

At the Harvard College Observatory it was found that the Large Magellanic Cloud contains some 214,000 stars, each at least 100 times as bright as our sun, along with a gaseous nebula so brilliant that about 15,000,000 suns would be required to rival it.

The tiny planet or asteroid, Eros, which paid its closest visit to the earth, reaching a point only 16,200,000 miles away, was found by astronomers at the Union Observatory, Johannesburg, South Africa, to be shaped like a long spindle.

The star Antares was observed as a disc, not as the point of light that a star usually presents, when Professor K. Nakamura, of the Kwasan Observatory, Kyoto, Japan, watched it reappear from behind the moon at occultation on January 15.

The star known as xi Ursae Majoris, in the Great Bear constellation, which appears to the naked eye as a single body, is in reality four bodies, arranged in two pairs. This was discovered by Louis Berman working at the Lick Observatory.

The greatest double star yet measured, 184 times as massive as the sun, was described by Dr. J. A. Pierce, Dominion Astrophysical Observatory, Victoria, B. C.

A variable star which flashes out brightly every 100 minutes, the most rapidly flashing star known to astronomers, was discovered by H. van Gent, of the Leyden Observatory, Holland, working at the Union Observatory, Johannesburg, South Africa.

Five eclipses, three of the sun and two of the moon, occurred during the year, none of particular scientific interest.

The weight of Neptune's satellite was calculated by three Mount Wilson Observatory astronomers—Dr. Seth B. Nicholson, Dr. Adrian van Maanen and Howard C. Willis—as not greater than one tenth or less than four one-hundredths the earth's mass.

Sun-spots were few in number this year as the sun approached the minimum of the 11-year cycle; long-distance radio reception was proportionately improved.

Observation of the sun's corona, without the aid of an eclipse, with the use of a very sensitive polarimeter was reported by M. B. Lyot, astronomer at the Meudon Observatory, near Paris.

Twenty years of research on the relation between solar radiation and weather on the earth were summarized by Dr. C. G. Abbot, indicating a possibility of future long-range forecasting of weather.

The height of the Aurora Borealis was measured by Professor J. C. McLennan, Dr. Hugh Wynne-Roberts and Dr. H. J. C. Ireton, of the University of Toronto, and found to be only 50 to 75 miles from the ground.

An amateur astronomer, Masani Nagata, a foreman in a California melon patch, discovered with the aid of a small telescope a comet which was subsequently named after him.

A new comet, so bright that it might have been found with the naked eye, was discovered by Percy M. Ryves, an English amateur astronomer at Zaragoza, Spain.

Neujmin's comet made its first return to the neighborhood of the earth, and was the second one of Saturn's "family" of comets to be observed more than once.

Encke's comet, returning to the neighborhood of the sun on its regular visit which it makes every three and one quarter years, was observed photographically, June 21, by Señor Bobone, of the Cordova Observatory, Argentina.

Chemistry

Discovery of the last missing chemical element, ekaiodine, number 85, was announced by Professor Fred Allison, Edgar J. Murphy, Professor Edna R. Bishop and Anna L. Sommer at the Alabama Polytechnic Institute, who used the same method in claiming detection of element number 87 a year ago.

Discovery of element 87 was claimed by Professor Jacob Papish and Eugene Wainer, of Cornell, who used the x-ray spectrograph.

Hydrogen atoms twice as heavy as, but otherwise identical with, ordinary hydrogen atoms, were detected by Professor Harold C. Urey and Dr. G. M. Murphy, of Columbia, and Dr. F. G. Brickwedde, National Bureau of Standards.

Commercial production of a new synthetic rubber-like substance, with grease-resisting properties, was begun by the E. I. du Pont de Nemours and Company. Acetylene, formed from calcium carbide, is combined with hydrochloric acid and polymerized to give chloroprene.

Dr. Fred Allison and Edgar J. Murphy, of the Alabama Polytechnic Institute, discovered in using magneto-chemical analysis, that gold, platinum and five other chemical elements are mixtures of atoms chemically the same but different in weight.

"Autosynthetic cells" which resembled closely living matter were produced in the laboratory by Dr. George W. Crile, of Cleveland.

Mechanical molecule models which enable the chemist to observe visually vibrations like those of the atoms and thus to obtain information regarding the motions were constructed by Dr. C. F. Kettering, director of the General Motors Research Laboratories, Professor D. H. Andrews, of the Johns Hopkins University, and L. W. Shutts.

A rich deposit of pitchblende, at LaBine Point on the Great Bear Lake of Canada, bearing probably $7,000 worth of radium to the ton, was found by Gilbert LaBine and Shirley R. Cragg.

A new essential to life, in addition to the twenty amino acids known as the chemical building blocks of necessary food proteins, was found in the casein or protein of milk by Dr. W. C. Rose, of the University of Illinois.

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That the chemical para-ethoxy-phenyl-thio-carbamide is intensely bitter to some persons, but tasteless to others was discovered by Dr. Arthur L. Fox, du Pont chemist.

Professor L. H. Snyder, of the Ohio State University, and Dr. A. F. Blakeslee, of the Carnegie Institution of Washington, working independently, found the "taste blindness" to para-ethoxy-phenyl-thio-carbamide to be a recessive hereditary trait.

Amylase, a digestive ferment of the pancreas that acts on the starch in foodstuffs and makes it available for the energy needs of the body, was isolated in pure crystalline form by Professor H. C. Sherman, of Columbia University, and his two associates, Professor M. L. Caldwell and L. E. Booher.

A crystalline form of vitamin D, called "calciferol," was prepared by a group working at the National Institute for Medical Research, London.

Protein crystals of great digestive power were isolated from trypsin, a digestive ferment secreted by the pancreas, by Drs. John H. Northrop and M. Kunitz, of the Rockefeller Institute for Medical Research, helping to clear up the mystery of the chemical mechanism of digestion.

Methyl, the atomic grouping found in poisonous wood alcohol, was isolated as a free radical for a small fraction of a second by Professor F. Paneth and W. Hofeditz, of the University of Königsberg, Germany.

Sir Robert Hadfield, father of modern alloy steels, found that analyses of seventy-nine specimens of steels and alloys belonging to Michael Faraday show that Faraday anticipated present developments of stainless and other special alloy steels.

Geology and Geography

Two severe droughts occurred in the United States during 1931; the northwest part of the country had the driest growing season on record, but later the drought moved to the southeast and that part of the country had the driest fall on record. The upper Mississippi Valley, however, had the wettest fall on record, the rainfall for November being 300 per cent. of normal.

The year 1931 was the warmest throughout the United States ever known to the U. S. Weather Bureau officials.

The ice season in the North Atlantic was the most extraordinary ever recorded by the U. S. Hydrographic Office, as up to June 11 no icebergs were sighted south of latitude 48 in the waters of the eastern slopes of the Grand Banks.

Five destructive hurricanes took toll during the year.

Seismological reports of fifty-four earthquakes were collected and epicenters located by *Science Service* in cooperation with the U. S. Coast and Geodetic Survey and the Jesuit Seismological Association; these included eleven destructive shocks of which five were severely destructive in populated regions of Mexico, Jugoslavia, the Balkans, Nicaragua and Transcaucasia.

A rock fall changed the familiar contours of Niagara Falls.

The age of the earth is at least two thousand million years, a National Research Council committee estimated by reviewing evidence given by radioactive minerals.

The world's largest meteorite yet discovered, a mass of iron and nickel weighing some seventy to eighty tons and measuring nearly fourteen feet long, was reported found by a Johannesburg land surveyor in the Tanganyika region of Africa.

One of the largest mastodons ever discovered in America was found near Cromwell, Indiana, by a ten-year-old boy, Donovan Harper, when he stubbed his toe over one of the molar teeth which weighed eight and one fourth pounds.

The world's first complete collection of skeletal remains of the Plesippus, a little-known ancient horse living more than a million years ago was unearthed in Idaho by Normal H. Boss, of the U. S. National Museum.

Fossil plants on St. Lawrence Island are direct evidence that the island is a fragment of the old land bridge which presumably linked Asia and America long ago, it was reported by Dr. Ralph W. Chaney, of the Carnegie Institution of Washington.

The Trans-Asia Expedition, led by Georges-Marie Haardt and using tractors in transportation, pushed its way from Beirut into Chinese Turkestan.

The giant airship *Graf Zeppelin*, under the command of Dr. Hugo Eckener, made a flight over the Arctic region, changing Arctic maps.

Engineering

The George Washington bridge across the Hudson River, a suspension bridge containing the longest clear span in the world, 3,500 feet, was completed.

Two steel arch bridges, the largest of their kind in the world, were completed this year—one, the Bayonne bridge across the Kill Van Kull and connecting Staten Island with New Jersey, is 1,652 feet one inch long; the other, the Sydney harbor bridge in Australia, is 1,650 feet.

A natural gas pipe line nearly 1,000 miles long was completed from Texas to Chicago.

A new ribbon type of microphone, which will exclude the grind of a camera and pick up only the desired sounds, was introduced by Harry F. Olson, of R. C. A. Photophone.

The Diesel engine was adapted to a racing automobile by C. L. Cummins, of Columbus, Indiana, in a car that would burn crude oil and would run at 100 miles per hour for 1,200 miles without refueling.

The final design was accepted and construction was begun on a hydraulic laboratory for research on floods, dam construction, irrigation and other hydraulic problems at the National Bureau of Standards.

The invention of a new rotor type of windmill, which will harness the power of the moving air, ventilate buildings, generate power from the tides and draw smoke from stubborn chimneys, was announced by S. J. Savonius, of Helsingfors, Finland.

Stroboscopic motion pictures enabling one to see photographs of rapidly whirling machinery as though it were moving at a visible rate were made.

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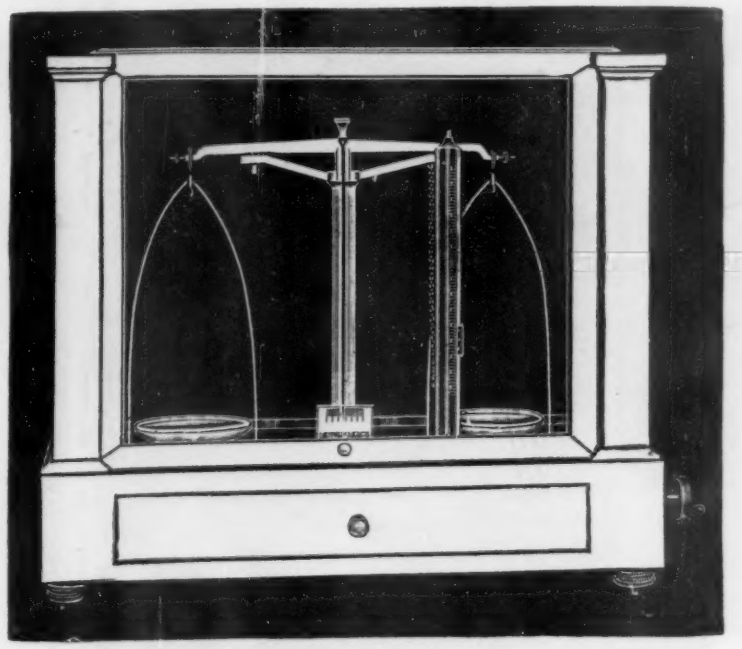

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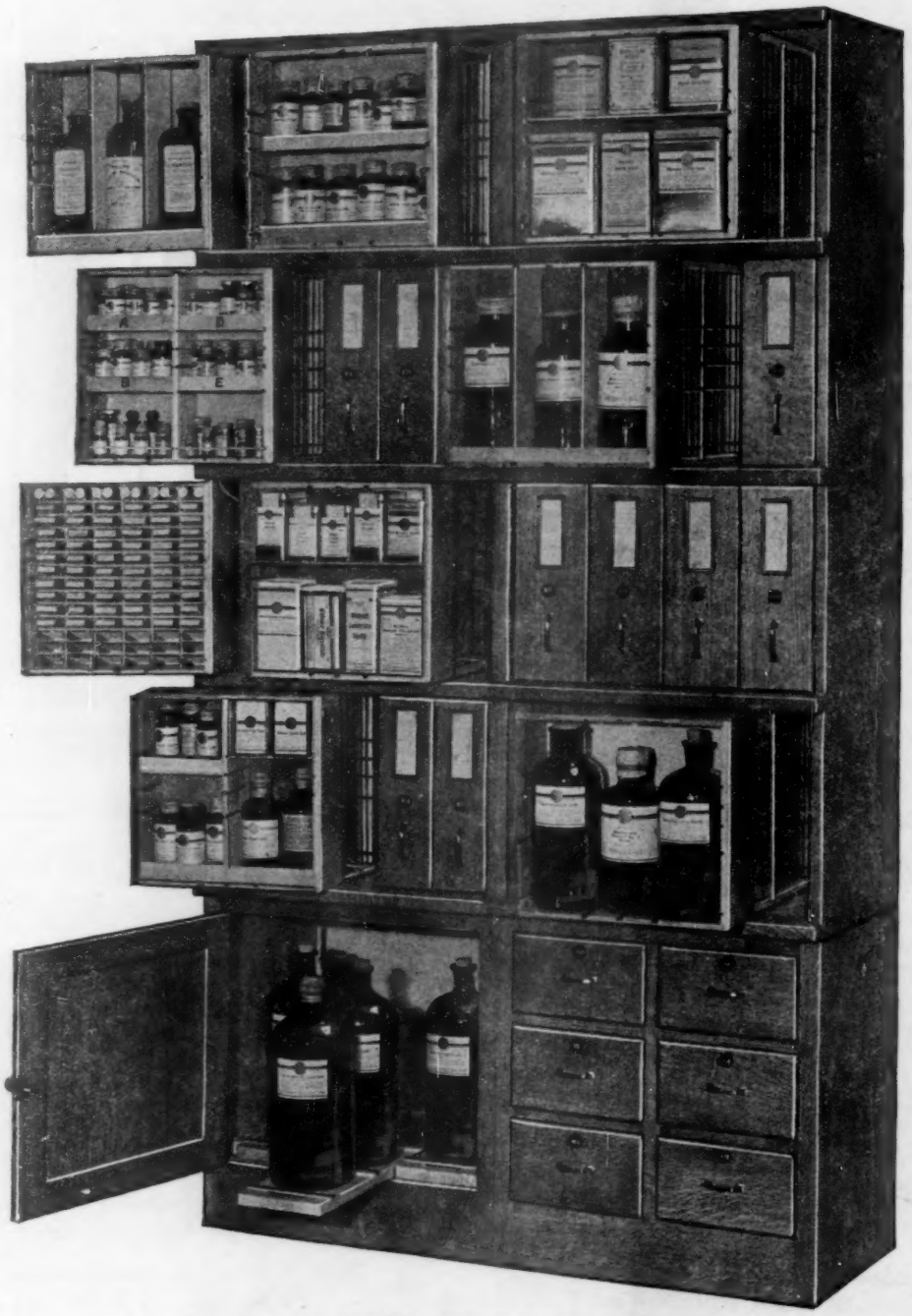

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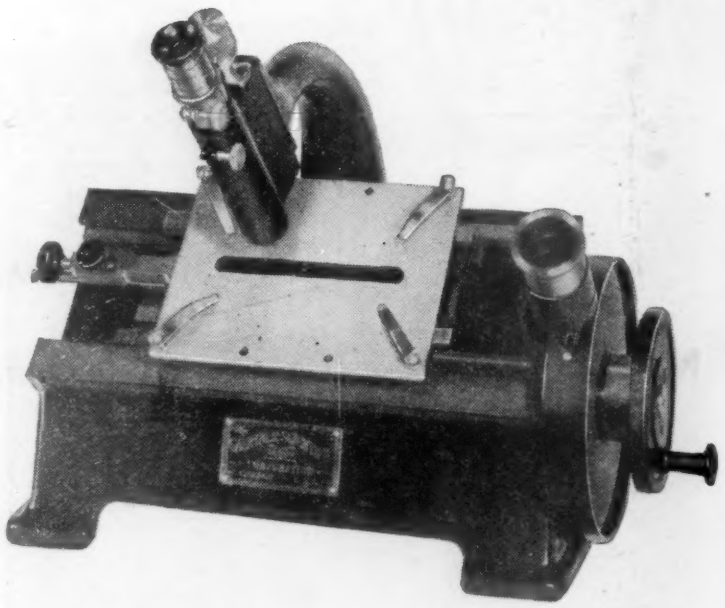

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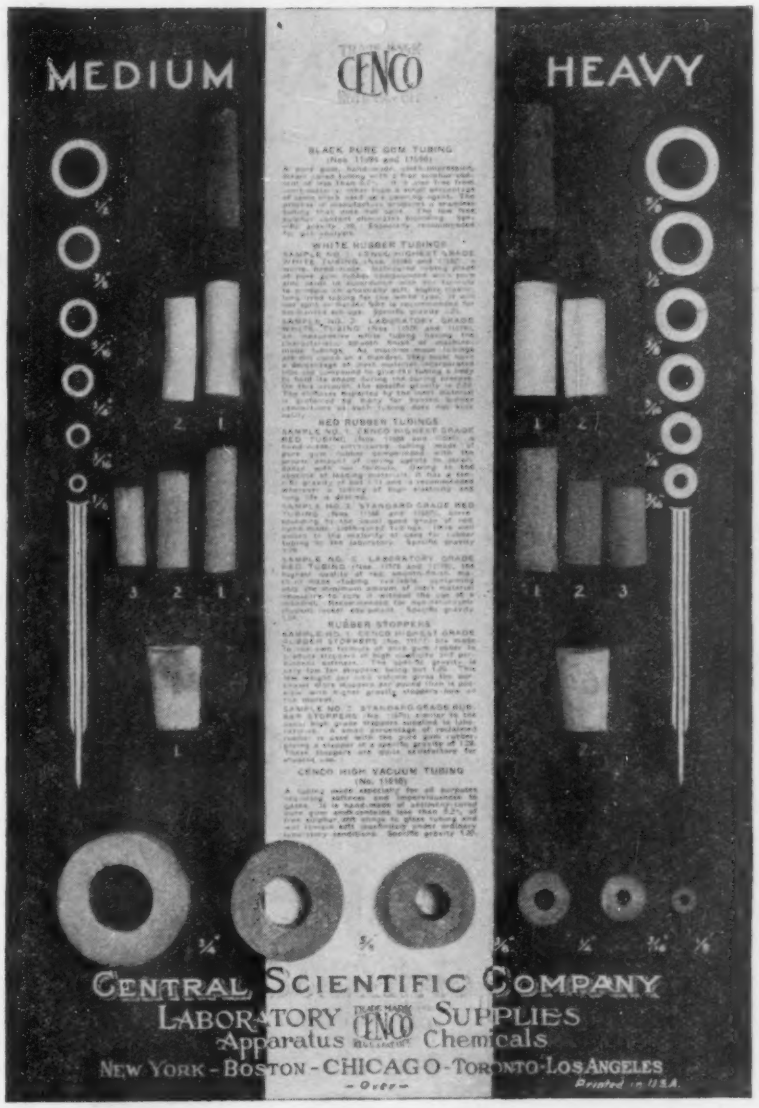

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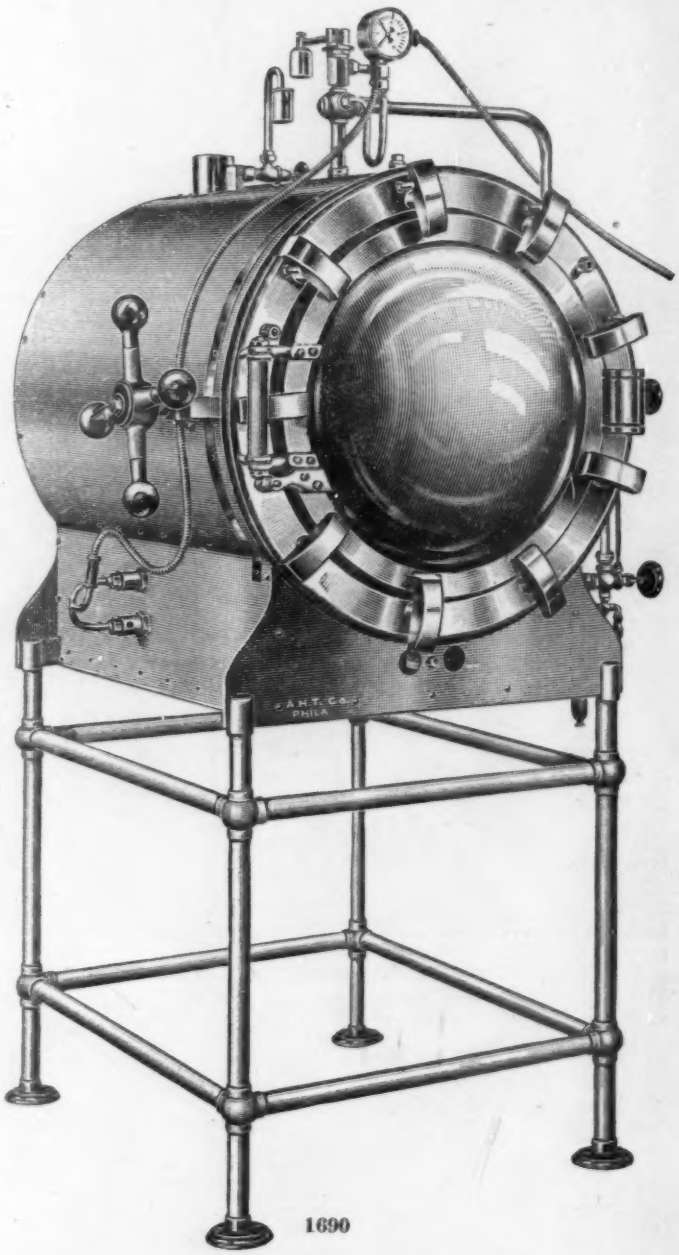

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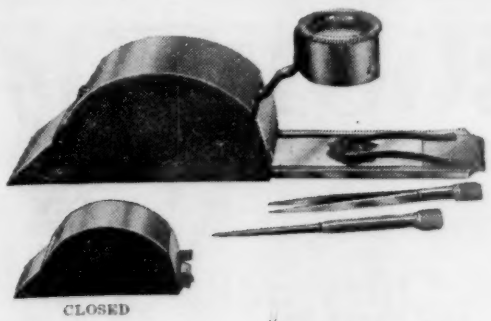

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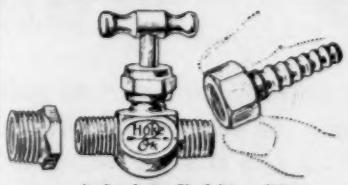

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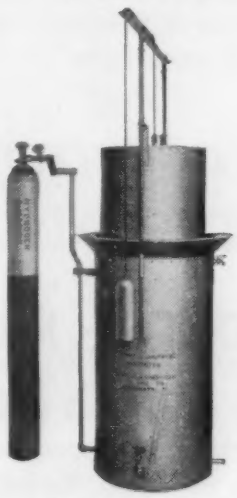

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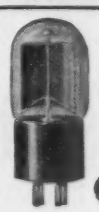

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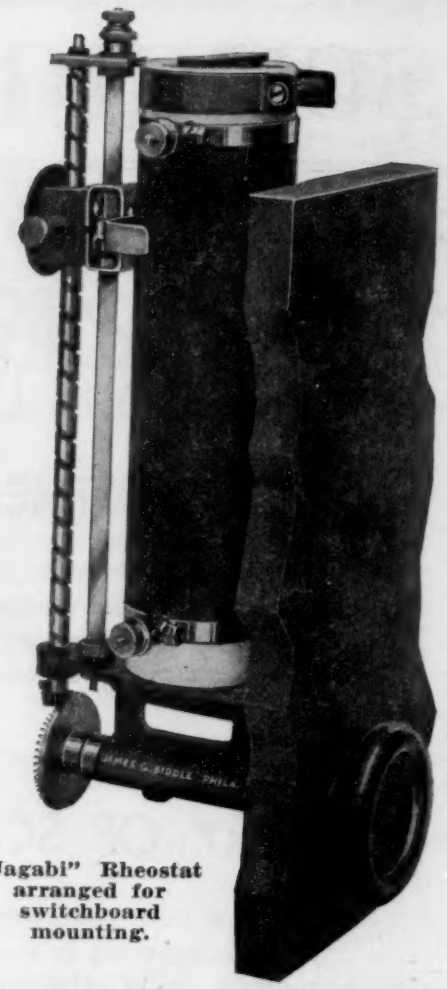

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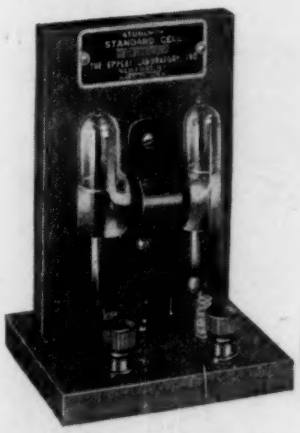

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Same stand as DSA-1, but with aplanatic condenser n.a. 1.4 and Apochromatic Objectives: 10 n.a. 0.30, 20 n.a. 0.65, 40 n.a. 0.95 and 90 n.a. 1.3 (Oil Immersion). Paired Compensating Oculars: 7x, 10x and 15x. Magnifications: 70x to 1350x.

Price, $400.50 f. o. b. N. Y.

A satchel type of carrying case can be supplied instead of the standard cabinet, at an additional cost of $4.00

CARL ZEISS, INC.

485 Fifth Ave., New York

Pacific Coast Branch: 728 South Hill Street, Los Angeles, Calif.

CARL ZEISS JENA